Assessing attitudes towards welfare and pain in farm animals

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To Robert and my parents, for their love, support and patience.

Declaration

I declare that I have composed this thesis, and that the work described is my own. All assistance has been acknowledged. The work has been submitted for no other qualification.

Carol Thompson

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List of abbreviations

AES	Animal empathy scale
ANOVA	Analysis of variance
APL	Attitudes to pain in livestock
BAM	Belief in animal mind
CAO	Central applications office
CODD	Contagious ovine digital dermatitis
df	Degree of freedom
DEFRA	Department for Environment, Food and Rural Affairs
EU	European Union
ER	Emotional reaction
FAWC	Farm Animal Welfare Committee
FDR	False discovery rate
IASP	International association for the study of pain
L	Lameness
LPER	Lameness, pain and emotional reaction
P	Pain
PCA	Principal component analysis
QMEE	Questionnaire for the Measurement of Emotional Empathy
NSAIDs	Non-steroidal anti-inflammatory drugs
REML	Restricted maximum likelihood
RVC	Royal Veterinary College
SE	Standard error
SRUC	Scotland's Rural College
SPSS	Statistical Package for the Social Sciences
UK	United Kingdom
UCAS	Undergraduate courses at university and college
TPB	Theory of planned behaviour
VAS	Visual analogue scale

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Abstract

Within the livestock sector, farmers and veterinarians are two groups of people who play a pivotal role in maintaining the health and welfare of animals. How the different welfare needs of farm animals are perceived and prioritised by these two caretaker groups will have direct implications for the animals in their care. People's perceptions and attitudes directly influence their behaviour, and research has demonstrated that positive attitudes towards animals are paramount to ensuring good animal welfare. The prevention and mitigation of pain is an important component to ensuring good animal welfare, as pain has the potential to negatively affect both physical and mental health. How pain in animals is perceived by farmers and vets will influence how it is managed. Therefore, understanding how farmers and vets: view the capacity of animals to experience pain, perceive the pain severity associated with different conditions and procedures, view the importance of pain mitigation in relation to other welfare needs, and deem the necessity of analgesic use in livestock, is vital. Four separate questionnaire based studies were conducted to assess these attitudes in farmers and veterinarians as well as in agriculture and veterinary students, as these students will be the next generation of farmers and veterinarians.

Overall, farmers and vets were found to have positive attitudes towards pain in livestock. Although the capacity of cattle and sheep to feel pain was perceived to be lower than that of humans it was still rated highly. In addition, positive beliefs about the benefits of pain alleviation, the negative impacts of pain on production and welfare, and the importance of prompt treatment and pain management for good welfare were held. Cattle farmers had more positive attitudes towards pain and analgesic use than sheep farmers. This difference was most evident around areas of resource availability, such as time and labour, and the practicalities associated with pain identification and drug provision. Farmers, vets and students perceived lameness to be a painful

condition, with the perceived severity of pain being closely related to the perceived severity of the disease. In addition, participants reported a greater emotional reaction in instances where they rated lameness and pain more highly. Furthermore, a positive relationship was found between lameness, pain and emotional reaction scores and the decision to catch a lame sheep for inspection. The majority of students had positive views towards pain in farm animals, believing that: farm animals were capable of experiencing pain, prompt treatment and the provision of pain relief were the two most important elements of welfare, and that farm animals benefit from pain alleviation. However, there was a perceived difference between a number of animal species in their capacity to feel pain, with livestock species being viewed as having a lesser capacity than companion animals and humans. In addition effects of gender were found, with females reporting higher levels of empathy and compassion towards lame sheep, and rating pain higher. Furthermore, female students had a stronger belief that animals were sentient beings than did males.

These four studies found that views on pain and analgesic use in livestock were generally positive. However, differences between individuals and between groups were found in a number of areas including how observers perceived the severity of painful conditions and procedures and in the capacity of different animal species to experience pain. These differences in attitudes may affect the decisions farmers and vets make regarding the treatment of pain, which is likely to have implications for farm animal welfare.

Chapter 1 General Introduction

1. Introduction

Freedom from pain is an important component of animal welfare. However, farm animals sometimes experience both acute and chronic pain during their lives. In many cases this pain is not routinely mitigated by the use of anaesthetic or analgesics, and as a result animals are likely to suffer. This literature review aims to provide an overview and synthesis of research on the main causes of pain experienced by farm animals and the most commonly cited barriers to preventing, and treating this pain. The term 'farmer' will be used throughout; its use covers stockpersons and producers, as well as farmers. The term 'analgesic' or 'pain relief' is used to describe drugs used to relieve pain and is therefore distinct from 'anaesthetics', drugs used to eliminate sensation. 'Pain medication' will be used when jointly discussing these two forms of drug. 'Animal' is used throughout, in place of 'non-human animal'.

The phrase 'positive attitude' appears extensively throughout this thesis and the literature (Abeyesinghe et al., 2013; Becker et al., 2013; Cardoso et al., 2016; Coleman et al., 2003; Ellingsen et al., 2010; Hanna et al., 2009; Ison and Rutherford, 2014; Kauppinen et al., 2012; Knight and Barnett, 2008; Knight et al., 2004; Levine et al., 2005; Loughnan et al., 2010; Maruščáková et al., 2015; Morovati et al., 2008; Muri and Valle, 2012; Muri et al., 2012; Ormandy and Schuppli, 2014; Serpell and Paul, 1994; Signal and Taylor, 2006; Thomsen et al., 2016; Väisänen et al., 2008; Waiblinger et al., 2006; Wells et al., 2011; Wikman et al., 2013; Williams and Muldoon, 2010; Willock et al., 1999). It could be argued that it is inappropriate to use the term 'positive' as it attaches valence to an attitude, and by attaching valence we assign judgement. However, I argue that it can be appropriate to attach valence to an attitude based on the corresponding benefit or detriment that attitude may hold. A principal motivation of animal welfare research is to identify ways in which the welfare of animals can be improved. This requires the interpretation of results by researchers who will ultimately place a value judgement on their findings. With regard to animal pain and analgesic use I therefore define the term positive attitude as: '*to hold a view or belief that is consistent with the idea that pain is detrimental to animal welfare, and therefore its prevention or treatment is good for animal welfare*'. Throughout the thesis it is therefore explicitly stated that certain statements or attitude dimensions represent 'positive attitudes'. This does reflect the value judgment that holding these attitudes is better for animal welfare and that encouraging and promoting the growth and development of these attitudes is of value.

2. Animal Welfare

There are differences in the views that people hold with regard to what animal welfare means, here three traditional classifications are discussed. The predominant view from the veterinary medicine and animal science fields is that good animal welfare means good physical health (Dawkins, 2006). McGlone (1993) suggested '*that an animal is in a poor state of welfare only when physiological systems are disturbed to the point that survival or* *reproduction are impaired*' (McGlone, 1993). This definition of animal welfare brings with it the potential for claims that animals that are continuing to produce or grow, by definition have good welfare. However increased knowledge and improvements in breeding programmes and selection for high producing animals can mean that animals continue to produce even when their physical fitness is impaired (Rauw et al., 1998). Ruth Harrison, in her expose ('Animal Machines') on intensive farming practices in the UK, post-World War II, highlights the need for more than just good physical health to ensure good welfare, such as an animal's need for behavioural freedom or 'naturalness' (Harrison, 1964). Subsequent investigation of intensive farming practices resulted in the publication of a report by a scientific advisory committee that agreed that behavioural restriction was not conductive to good welfare, stating that '*In principle, we disapprove of a degree of confinement of an animal which necessarily frustrates most of the major activities which make up its natural behaviour*' (Brambell, 1965). Others such as Bernard Rollin believe that 'naturalness' is an essential component of welfare, as it supports the '*nurturing and fulfilment of the animal's nature, [or] telos*' (Rollin, 1993).

The third traditional view on welfare focuses on the psychological state of the animal. This view asserts that it how an animal feels about its situation that is truly important. This is often referred to as the 'affective state' of the animal. Ian Duncan stated that '*neither health nor lack of stress nor fitness is necessary and/or sufficient to conclude that an animal had good welfare. Welfare is dependent upon what animals feel'* (Duncan, 1993).

How animal welfare is defined will have direct implications on how animal welfare science is conducted and how animal welfare is ultimately assessed. The three different approaches presented here could assess the same animals and come to different conclusions, which could ultimately affect how those and other animals are kept and treated in the future. This is demonstrated in the following example of tethered sows from Fraser et al. (1997). An observer using the 'physical health' definition of welfare may conclude that the animals have good welfare because they are fed, watered, warm, and are free from disease. However an observer using the 'affective state' based definition of welfare may conclude that the pigs have poor welfare based on their behaviour: escaping when possible and vocalising, potentially due to frustration. A 'naturalness' observer would also come to this conclusion as tethering the animals will limit or prevent the sows from performing a range of natural behaviours. Fraser et al. (1997) propose that all three of these definitions of welfare are important and need to be addressed by animal welfare researchers, as they all represent real ethical concerns expressed by society. This thinking led to the development of the 'Three Circles of Animal Welfare' framework (Figure 1.1) which advocates the consideration of all three elements, 'physical health', 'affective state' and 'naturalness', when discussing animal welfare. Other animal welfare frameworks such as the Five Freedoms (which will be discussed in more detail later) also approach animal welfare with this multi-faceted view (FAWC, 2011).

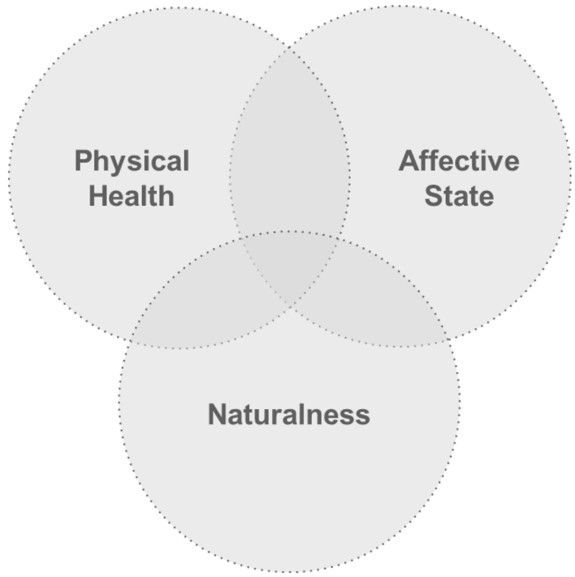

Figure 1.1. The Three Circles of Animal Welfare

Although frameworks such as the Three Circles and the Five Freedoms allow for a more comprehensive view of animal welfare, conflicts can also exist between the different elements. For example following the 'naturalness' approach and allowing animals to live a more natural life outdoors may mean greater risk to physical health, for example from parasitism (Lund and Algers, 2003) or disease (Dwyer, 2008).

There are also likely to be conflicts between these definitions as to whether or not it is acceptable that animals experience pain untreated. Those who follow the 'affective state' definition of welfare would likely condone animals experiencing pain especially if experienced chronically or unnecessarily. Those following the 'physical health' mentality would only view pain as a welfare problem if experienced to the degree where normal bodily function was impaired, such as a suppressed immune system or reduced growth and performance. Those following the 'naturalness' definition may however disagree that pain negatively impacts on welfare because pain is a natural part of life with an important function. Or perhaps they would take into account the cause of the pain, perhaps accepting pain experienced during parturition but condoning the pain experienced from human interference such as that caused by castration.

Dawkins has proposed that improvements to animal welfare can be made by asking two questions: '*is the animal physically healthy and does it have what it wants*? (Dawkins, 2003). Dawkins argues that part of the strength of this approach to assessing animal welfare is in its simplicity (Dawkins, 2008). For this thesis I choose to use Dawkins definition of welfare as it includes the two important elements of, physical and mental health, whilst also overcoming the difficulties in attempting to separate what parts of a natural life are potentially positive or negative. It is a useful definition when considering the potential welfare implications of pain, as by asking what an animal wants we can assess an animal's desire to alleviate current pain or prevent future pain by studying their behaviour, which will be briefly discussed in the next section. In addition it allows for the consideration of any physical health implications that may arise as a result pain experiences.

3. Defining & Assessing Animal Pain

Pain is defined by the International Association for the Study of Pain (IASP) as, "*an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage*" (Merskey and Bogduk, 1994). However the IASP note that the inability of an individual to communicate pain does not negate the pain felt, as is also the case for neonates, and non-verbal humans. A specific animal pain definition has been proposed by Molony and Kent (1997). They define pain as "*an aversive sensory and emotional experience representing an awareness by the animal of damage or threat to the integrity of its tissues. It changes the animal's physiology and behaviour to reduce or avoid the damage, to reduce the likelihood of recurrence and to promote recovery*" (p.266.). Both of these definitions highlight the importance of both the sensory (nociceptive) and emotional components (Rutherford, 2002) of pain, which is an important advancement from the traditional view of pain as an entirely sensory phenomenon (Lamont et al., 2000). It is necessary to highlight that nociception and pain are not one and the same, as each can occur without the other (Loeser and Treede, 2008). Nociception is the neural process of encoding a noxious stimulus, it becomes pain when the noxious stimulus is consciously perceived (Stubsjoen, 2010).

Knowing whether or not an animal species possess the capacity to experience pain is important as we have an ethical (Verrinder et al., 2016) and sometimes legal (Foreign and Commonwealth Office, 2008) obligation to protect their welfare. Pain capacity criteria were proposed by Bateson over 25 years ago (Bateson, 1991) and have more recently been modified by Sneddon et al. (2014) in light of improved knowledge and understanding regarding pain. The following criteria and discussion on these criteria is based on the paper by Sneddon and colleagues, please see for full details.

The criteria are based on an animal having the appropriate mechanisms to:

1. Detect – nociceptive and neural apparatus to detect and respond to tissue damage.
2. React – whole animal response to noxious stimuli such as physiological and behavioural change.
3. Respond - evidence of long-term motivational change that might include rapid learning.

Detect

The first criterion is that animals have the capacity to detect and respond to tissue damage. All vertebrates share certain anatomical and physiological traits and display similarity in their behavioural responses to painful stimuli (Stafleu et al., 1992). The analogous sensory mechanisms that detect and process noxious stimuli are generally accepted to be present in all vertebrates (Flecknell, 2008). Vertebrates possess virtually identical nociceptors and nerve fibres (A&C fibres) that carry nociception signals to the spinal cord and lower parts of the brain where the information is processed in a similar way. It is therefore logical to accept that the physical component of pain, nociception, is comparable across vertebrates. However differences in information processing start to occur at the cerebral cortex (Flecknell, 2008). As a result of these differences and the impossibility of directly investigating emotional states it is not possible to say how similar the emotional experience of pain is between humans and non-human animals. It is likely that although the experience of pain is similar, it is not the same (Molony, 1992). When viewed from an evolutionary perspective it is logical to propose that the ability to feel pain is a functional adaptation to life that enhances survival and is unlikely to be a uniquely human experience (Rutherford, 2002). Dawkins (1998) proposes that pain evolved to stave off death, by being unpleasant.; for pain to be functional the affective element is essential (Dawkins, 1998). The necessity of the aversive element of pain can be seen from the work of leprosy surgeon Paul Brand. Brand developed an artificial pain system to warn leprosy sufferers, through an electric shock system, of potential damage. However patients choose to turn the equipment off, thereby eliminating its effectiveness (Brand and Yancy, 1994). These findings have been interpreted as the need for not just the information regarding tissue damage but also the need for a motivational force that is beyond the suffers control (Auvray et al., 2010). Pain's effectiveness lies in its averseness.

React

The second criterion is that physiological and behavioural changes occur. Physiological changes such as those associated with the sympathetic nervous system and hypothalamic-pituitary-adrenal axis (HPA) are involved in many of the physiological changes associated with potential pain inducing stimuli. These responses can be confirmed either by measuring circulating catecholamines, adrenaline and noradrenaline, by the resulting autonomic changes such as increased heart rate of respiratory rate or by measuring corticosteroid hormones such as glucocorticoids. These changes are associated with negative states, such as pain and fear (see Sneddon et al., 2014).

Reaction to a noxious stimulus should also occur at a behavioural level. This can occur as an unconscious reflexive response, such as withdrawing a limb from a naked flame, which is processed in the spinal cord and not the brain (Weary et al., 2006), or consciously by the animal through the decisions and choices it makes (see Sneddon et al., 2014). Lambs that had been mulesed increased the time they spent standing and reduced the time they spent lying and feeding (Hemsworth et al., 2009), and lambs that had been tail docked were found to adopt abnormal postures such as standing immobile and hunching their backs or trembling (Graham et al., 1997). Behavioural studies such as these allow for comparisons to be made, either between treatment and control animals, or between different treatment groups. Comparing the behavioural and physiological responses of animals that have experienced different pain events can enable a comparison of the likely pain severity of the events. For example work on lambs has shown that certain methods of castration and tail docking induce more pain than others (Kent et al., 1993) and that castration is more painful than tail docking (Molony and Kent, 1997). It has been proposed that the most informative behaviours with regard to pain assessment are those that animals are highly motivated to perform (Weary et al., 2006). One example of this is that experimental rats that have to stand up to reach their food from the feeder reduce this activity after abdominal surgery (Roughan and Flecknell, 2000).

A number of these studies have also used anaesthetics and analgesics to investigate the potential existence of pain. Studies that have given pain medication to castrated or tail docked lambs have found behavioural and psychological differences between those that did and did not receive the pain medication. Lambs that received the pain medication engaged in lower instances of abnormal postures and had lower plasma cortisol than lamb that were un-medicated (Graham et al., 1997; Kent et al., 1998). Studies have also demonstrated that animals in pain may self-medicate. Lame chickens were more likely to consume feed that had an analgesic added to it than were non lame chickens (Danbury et al., 2000).

Prey species such as sheep may attempt to mask signs of pain or ill health so as to not appear weak to potential predators (Kaler and Green, 2008a). It is important to take this into account when observing animals or attempting to assess animal pain. Observations are likely to be more accurate if animals are undisturbed and do not feel threatened (Kaler and Green, 2008a).

Respond

The third and final criterion is that animals modify their behaviour in the long-term, that some form of learning has occurred. Some animals have been found to avoid areas where they had previously experienced a painful event, for example sheep will avoid a runway where they had previously experienced electric shocks (Rushen, 1986) and rats will try to avoid being shocked by using their bedding to cover electrodes in their cage (see Sneddon et al., 2014). Evidence of the awareness of tissue damage can also be seen in a variety of species where animals lick or rub the pain site on their body, for example in calves following castration (Molony et al., 1995).

The potential for pain capacity in different species can be established beyond reasonable doubt by using these criteria to design experimental studies. But these criteria must be considered as a whole and not as indicators in isolation.

The majority of the examples mentioned above concern mammals, and most people within the scientific community and broader society appear to accept that mammals have the capacity to experience pain. However there is less of a consensus for other taxa such as fish. But by applying these criteria their capacity for pain can be established. For example researchers (for a review see Braithwaite, 2010) have conducted experiments designed to answer questions regarding, the presence of external and internal mechanics for pain detection and response, and subsequent behavioural changes. Studies on trout have identified the presence of nociceptors and A&C nerve fibres necessary to detect noxious stimuli and transmit this information to the spinal column and the brain. Therefore trout have the ability to 'detect' noxious stimuli. Further studies involving the injection of a noxious stimulus into the lips of trout found that respiration and feeding motivation were affected, and that the trout would rub the injection site – the site of potential pain – along the tank and gravel. Therefore trout 'respond' to noxious stimuli. And finally research has demonstrated that trout learn to avoid areas of the tank where they had previously received electric shocks.

The first part of this section has provided a brief summary of how pain capacity can be assessed in animals based primarily on the Sneddon et al. (2014) review. The focus has been on mammals as the species of interest in this thesis are mammals. However these criteria can, and have been used to investigate potential pain experiences in other vertebrate and invertebrate species. The conclusions the authors draw is that the evidence supports the conclusion that many vertebrate species have the capacity to experience pain-like states and that although we can never be certain of the internal state of another organism the evidence that vertebrates do experience pain is beyond reasonable doubt.

4. Pain & Animal Welfare

Freedom from pain is an extremely important component to any being's welfare (Anil et al., 2002). Pain has the potential to negatively impact both physical and mental health (Viñuela-Fernández et al., 2007), and can greatly increase recovery time from the initial condition (Hewson et al., 2007a; Muir and Woolf, 2001). In addition, the existence of chronic pain (defined as 'pain which has persisted beyond normal tissue healing time' (IASP)), can lead to hyperalgesia (increased pain from a stimulus that normally provokes pain (IASP)) or allodynia (pain due to a stimulus that does not normally provoke pain (IASP)). Therefore, a situation that causes chronic pain may render the individual susceptible to experiencing subsequent stimuli as more painful than they would otherwise be. As a result, pain can cause reduced welfare at the initial time of occurrence but also potentially later in life. In spite of these welfare implications, pain is a commonly overlooked component of poor farm animal welfare.

Firstly, it is important to bear in mind that pain is subjective for both sufferer and observer (Coghill et al., 2003). As such, one individual's experience of pain may be different from another's (Coghill et al. 2003). Variables such as past experience, empathic tendencies and knowledge of animal behaviour (in the case of animal pain; Anil et al. 2002), may all play a part in how the observer will assess and rate the sufferer's pain experience. Secondly, an observer's knowledge and experience of pain assessment will directly impact on their ability to discern pain in another. Behavioural cues may be missed or their meaning misconstrued. Research in empathic accuracy suggests that people are relatively unsuccessful in inferring what others are experiencing and discrepancies in the estimation of pain between people in pain and observers are usually in the direction of underestimation by the observers (Goubert et al., 2005). It is likely that the same occurs in the assessment of pain in animals. Underestimation of pain and the subsequent non-use of analgesics will have significant repercussions for the welfare of animals. As such, there is a need to ensure that those responsible for animals' welfare are appropriately trained to be able to both accurately assess pain when present and to subsequently treat and manage it.

Pain, although unpleasant, plays an extremely important protective function in that it warns an organism of "*damage or threat to the integrity of its tissues*" (Molony and Kent, 1997, p.266). The potential welfare compromise occurs when pain is felt acutely, chronically, or when it is maladaptive, for example when pain persists past the point of tissue healing. Within its lifetime a farmed animal may experience both types of pain. Any attempt to completely eliminate pain experienced by farmed animals would be aspirational. However, great efforts should be made to change management procedures so that pain and distress are significantly minimised (Bath, 1998). Guatteo (2012) and colleagues highlight the 3S approach: 'suppress, substitute, soothe'. Suppression should occur at a management level, with the 'suppression' of unnecessary procedures, such as tail docking in dairy cattle (Guatteo et al., 2012). Similarly, the incidence of feather pecking amongst chickens can be significantly reduced through the introduction of dark brooders – designed to simulate the warmth and darkness of brooding under a mother hen's wing – negating the need for unnecessary beak trimming (Gilani et al., 2012). 'Substitution' involves the replacement of old techniques with new and improved ones that result in reduced pain and distress. And, finally, if it is not possible to suppress or substitute, or if pain is still present, then it is necessary to 'soothe' with the use of anaesthetics, and/or analgesics.

5. Painful Husbandry & Surgical Procedures

Painful husbandry procedures occur across all farmed animal species and management systems, and usually involve the removal of a sensitive part of an animal's body (Stafford and Mellor, 2010). For example, sheep (Fitzpatrick et al., 2006) and pigs (Guatteo et al., 2012; Veissier et al., 2008) are routinely castrated and tail docked, kids and calves from horned breeds are disbudded (Stafford and Mellor, 2010) and chickens and turkeys are beak trimmed (Stafford and Mellor, 2010). Many of these procedures are routine practice, for example 90% of male lambs are castrated in England annually (DEFRA, 2006). When extrapolated UK wide this figure is the equivalent of approximately 7 million male lambs being castrated each year. The rationale is that these husbandry procedures provide a benefit either to the animal or the farmer. In the case of castration the main drivers are to prevent indiscriminate breeding which may have implications for the welfare of mother and offspring, and the demand from producers for carcasses that do not possess certain undesirable characteristics associated with entire males (FAWC, 2008). However a significant proportion of lambs are slaughtered prior to sexual maturity (DEFRA, 2006) and therefore should not have developed these unwanted characteristics. Other benefits to the farmer from procedures such as disbudding, can be in the form of safer handling or reduced economic loss either as a direct result of injury or as a consequence of loss of life due to illness or infection (Molony et al., 2012; Stafford and Mellor, 2010). Benefits to the animal include a lower risk of suffering an injury such as that caused by tail biting in pigs (Taylor et al., 2010) and feather pecking in hens (Cunningham, 1992; Gentle, 1986; McAdie and Keeling, 2000), which can lead to cannibalism, infection and potentially death. However these husbandry procedures are painful (Marchant-Forde et al., 2008; McMeekan et al., 1999; Molony and Kent, 1997; Molony et al., 2012, 2002; Stafford and Mellor, 2011; Taylor and Weary, 2000; Weary et al., 1998) and, as such, steps should to be taken to reduce this pain. In addition, farm animals may have to undergo surgical procedures within their lifetime. These procedures will cause pain that should be mitigated using both anaesthetics and analgesics. Research indicates that the provision of anaesthesia and/or analgesia is not routine and animals are likely to experience pain as a result. This will be discussed in detail in section 9.1 Attitudes to pain and analgesic use in animals.

6. Disease & Ill Health

Farm animals may experience disease or ill health during their lifetime and some of these conditions will cause pain. How this is managed is of great importance for animal welfare. Disease and illness can negatively affect production and can cause mortality; it is therefore in the interests of both the animal and the farmer to treat it. However there are a number of painful conditions that affect farm animals that routinely go untreated. One prominent example of this is lameness, with an average UK prevalence of up to 36% for dairy cattle (Barker et al., 2010; Clarkson et al., 1996; Rutherford et al., 2009) and 10% for sheep (Kaler and Green, 2008b). Lameness is an inflammatory condition

(Green and George, 2008; Green et al., 2012) and inflammation is known to be painful (Muir and Woolf, 2001). Studies have found hyperalgesia in lame animals (Tadich et al., 2013; Tapper et al., 2013) and that the administration of analgesics reduces lameness (McGeown et al., 1999). There are 30 million sheep in the UK, and research suggests that over 3 million are lame at any one time (FAWC, 2011a). This has been a problem for decades and is costing the industry between an estimated £24 million (Nieuwhof and Bishop, 2005) and £80 million each year. (Wassink et al., 2010; as cited in Winter et al., 2015). More importantly it is a serious welfare concern causing poor body condition, increased mortality in lambs and ewes, and increased numbers of barren ewes (Wassink et al., 2010).

Lameness is a significant challenge for the sheep industry and the publication of the Farm Animal Welfare Council's (FAWC) 'Opinion on lameness' in 2011 has helped to increase awareness of this problem in the industry. The FAWC report recommends that lameness prevalence be reduced to at least 5% by March 2016 and to at least 2% by March 2021. In order to achieve this, the sheep industry has initiated a five-point plan to tackle lameness (Figure 1.2) (Agriculture and Horticulture Development Board, 2014). It recommends a cull policy for repeatedly lame animals; strict quarantine measures for infected and new stock; a management programme that emphasises the importance of prompt treatment of even mildly lame sheep; the improvement of practices and facilities to prevent the spread of disease during handling and gathering; and in the case of footrot, vaccination to establish flock immunity. It also details a decision tree (Figure 1.3) for the treatment of lameness providing images and descriptions of five main causes of lameness in the UK along with a recommended treatment plan.

Figure 1.2 Sheep industry lameness campaign – Five point plan

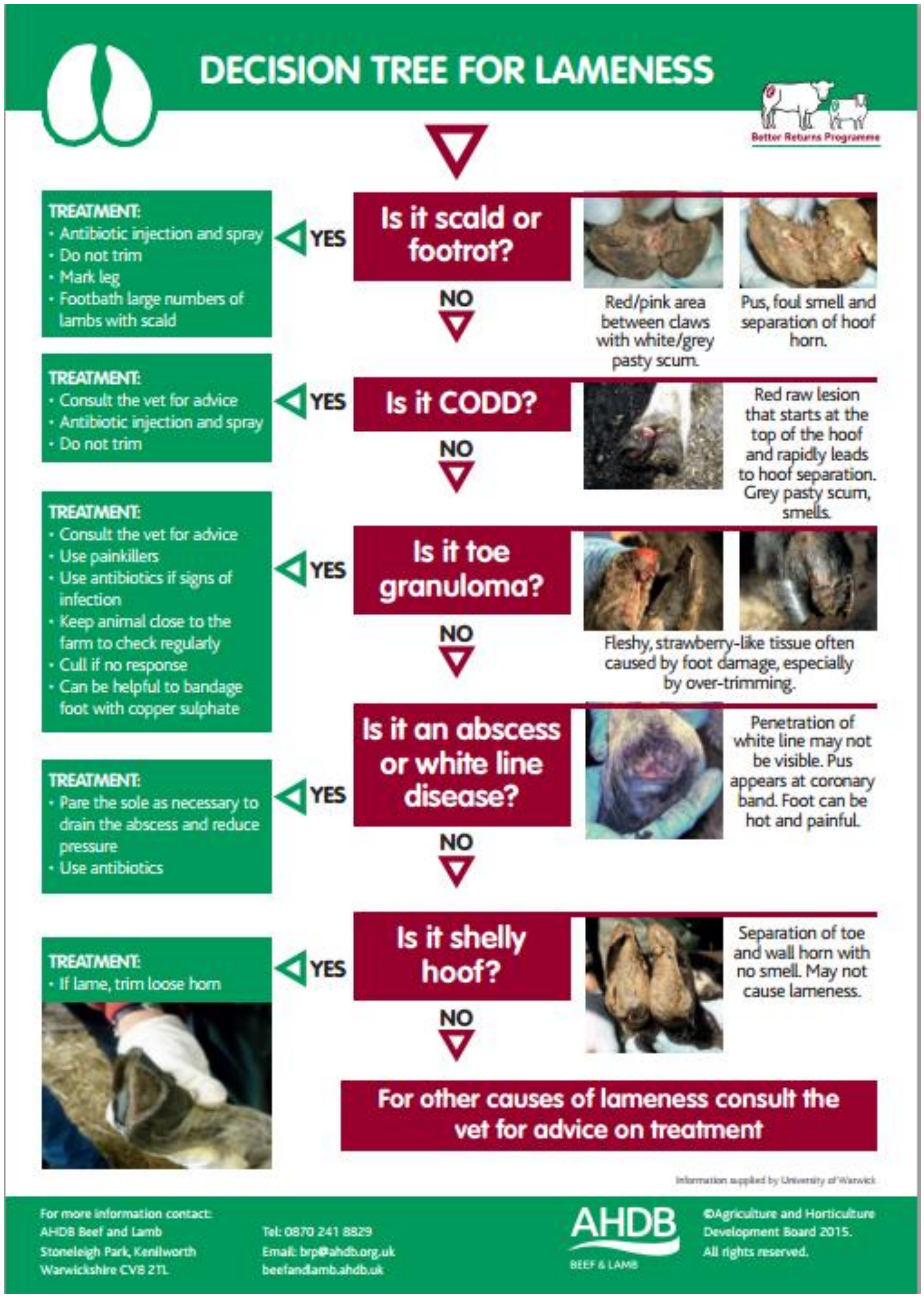

Figure 1.3 Sheep industry lameness campaign - Decision tree for lameness

Footrot and scald are painful conditions (Ley et al., 1994) and account for approximately 80% of lame sheep in the UK (Kaler and Green, 2009) yet analgesics are not listed as part of the lameness control plan. There is currently no published data on the provision of pain relief for animals with footrot and it is unlikely that affected animals routinely receive any. A UK survey of sheep management practices found that 63% of farmers never provided analgesia as part of the lameness management, and only 5% always did (Rutherford et al., *in prep*.)

7. Legislation & Regulations

This section will look at the legislative requirements and restrictions governing pain and painful husbandry procedures in livestock at an EU and UK level. In 1999 the Treaty of Amsterdam (European Communities, 1997) entered into force, introducing the Protocol on Animal Welfare which included legal obligations for Europe to regard animal welfare within their future laws and policies (Camm and Bowles, 2000). The Treaty of Lisbon (article 13) further states that "*since animals are sentient beings [we must] pay full regard to the welfare requirements of animals*" (Foreign and Commonwealth Office, 2008 p.41). However, **E**uropean legislation on farm animal pain is sparse and only provides specific guidelines on painful husbandry procedures in pigs, laying hens and broiler chickens. There are numerous other animal species farmed within Europe that do not have specific legislative protection at an EU level except for the limited instruction detailed in Council Directive 98/58/EC that animals *"[should not be] caused any unnecessary pain, suffering or injury"* (European Union, 1998).

Within the UK, animals are protected under the Animal Welfare Act (2006), which provides guidelines on a duty of care and regulations on the welfare of farmed animals. Within the act, pain is seldom mentioned. The use of anaesthesia is mentioned for certain procedures. It is illegal to dehorn or disbud cattle, or to castrate calves over two months and lambs over three months without anaesthesia. Analgesia is not mentioned. As under EU legislation 'unnecessary pain' is deemed unacceptable but no guidance is given on how to define 'unnecessary'.

The Animal Welfare Act has based its duty of care on the Five Freedoms, which in relation to pain states "an animal's need shall be taken to include its need to be protected from pain, suffering, injury and disease" (Kingdom, 2006). The Five freedoms is a welfare framework developed by the Farm Animal Welfare Council (FAWC, now the Farm Animal Welfare Committee), and modelled on the 1965 Brambell Report (Brambell, 1965a) that stated that farm animals should have freedom "*to stand up, lie down, turn around, groom themselves and stretch their limbs*". The Five Freedoms framework has been adopted by a number of organisations such as the RSPCA as their welfare guidelines for the keeping of all animals. The Five Freedoms however are a conceptual ideal and it can be impossible to ensure all of the Freedoms all of the time. For example, in the livestock industry there is often a conflict between the freedom to express normal behaviour and the freedom from hunger or thirst. Extensively reared animals are often perceived as having higher welfare than intensively reared animals as they have more behavioural freedom and are viewed as having a more natural life (Dwyer and Lawrence, 2008). However, animals in extensive systems may be at greater risk of not receiving treatment for an injury or disease as a result of less human-animal interaction. Therefore the system in which animals are kept will dictate to some degree what welfare compromises they are likely to be exposed to. Understanding how farmers view these trade-offs may be important for the welfare of the animals in their care.

In the UK there are a number of farm assurance schemes claiming to ensure higher welfare for animals, for example the Soil Association and RSPCA Assured (formally Freedom Foods). The Soil Association standards only explicitly mention pain in relation to handling and to cows left un-milked. For lambs they allow castration and tail docking using a rubber ring up to 7 days of age, and using burdizzo up to 6 weeks of age with anaesthetic. RSPCA Assured welfare standards (RSPCA, 2013) cite avoiding pain from handling, defective equipment, husbandry procedures and during the slaughter process. Castration and tail docking is permitted within the first week of life, however permission is required. Although the use of pain relief is not mandatory they do state that it “should be applied whenever possible” (p.24 & p.25). This is in contrast to the Soil Association, which does not mention the use of analgesics at all within their standards (Soil Association, 2014).

The Welfare Code, which is not legislatively binding, states that castration and tail docking of lambs only be performed on animals that will be retained past puberty to avoid welfare problems associated with the management of entire males lambs, and where flystrike is a risk. FAWC think farm assurance schemes should be doing more to discourage routine castration and tail docking, and state ‘*farm assurance schemes could be a very powerful mechanism to implement these parts of the Welfare Code but we found little evidence to indicate they there were effective in actively discouraging the practices*’ (FAWC, 2008).

Specific legislation exists for some welfare needs, for example space allowance. By law, each animal should have a minimum amount of space, for example laying hens are required to have a useable area of $750cm^2$ each (European Union, 1999). However pain, a clear welfare compromise, is not legislated for in any detail probably as a result of its subjective nature and the difficulty in quantifying it. Despite the lack of focus and clarity on pain and pain management, this policy context is designed to change farming practice to benefit animals' welfare. For policy to translate into practice behaviour change among those working directly with animals is necessary.

8. Changing Behaviour

In order to improve the welfare of livestock through the prevention or treatment of pain a behaviour change is needed. The management of animals affected by painful conditions such as lameness, and exposed to painful husbandry procedures, such as castration, needs to change either through prevention or cessation respectively, or through the use of anaesthetics and analgesics. However, encouraging behaviour change can be difficult. Tradition plays an important role in the farming industry. Challenging traditional practices with more welfare friendly alternatives can be a difficult task as it involves encouraging a new way of thinking. For example within the UK sheep sector lamb castration is common place and several million lambs are castrated annually (FAWC, 2008). The continued necessity of this practice has been questioned in light of the fact that lambs can be reared to slaughter age before sexual maturity (FAWC, 2008).

The multiplicity of factors involved in the performance of any particular behaviour further complicate the process of change (Ajzen, 1991). Therefore when attempting to change behaviour it is likely that a number of factors will have to be addressed in order to be successful. Within the farming industry there are likely to be numerous barriers to improving animal welfare such as: negative attitudes to animals (Coleman et al., 2003), lack of time or skilled labour (Morgan-Davies et al., 2006), insufficient funds or reduced profitability (Stott et al., 2011), perceived or real lack of knowledge (de Lauwere et al., 2012), lack of trust or belief in the change (Fredriksen and Nafstad, 2006), and disagreement with expected outcomes of the change. Change requires effort, and a new way of thinking. In addition there is the risk that those trying to change will feel incompetent or incapable of performing the task at hand. When attempting to implement change, in this case the reduction of painful procedures and provision of pain relief, it is important to be aware of all the variables that are likely to impact upon efforts made. The following discussion will firstly consider one of the theoretical models of behaviour change that has been used in the study of farming practices and then highlight research on the perceived barriers for the provision of pain relief.

8.1 A theoretical model for behaviour change

When it comes to trying to understand, predict and subsequently change human behaviour there are many theories and models to aid in doing so. One widely used theory will be briefly discussed to provide a basic overview of some of the components believed to be important for understanding behaviour. The 'theory of planned behaviour' (TPB) (Ajzen, 1991) is one of the most widely used behavioural models, taking into account a variety of both personally and culturally influential components and has been used to help understand farmers' behaviour and decision making practices (Beedell and Rehman, 2000, 1999; Fielding et al., 2008; Wauters et al., 2010) The TPB (Figure 1.4) details the importance, for attitude formation, of extrinsic elements (such as social and cultural beliefs) combined with intrinsic elements (like social norms and belief in one's own ability). Extrinsic elements are for the most part, out-with an individual's control and are independent of any one person; in contrast, intrinsic elements are a more cognitive component, determined by one's own beliefs and interpretation of social norms. In the context of pain mitigation behaviours, there are likely to be a variety of factors playing a role in attitudinal development, the decision making process and the subsequent behaviour of the stakeholder. Figure 1.4 shows how an individual's behavioural belief (the perceived consequences of a specific behaviour), combined with the beliefs of people around him, and his perceived ability to perform the behaviour in question will generate a behavioural intention. If this intention is positive and is supported by the circumstances of his community and culture, and he has the appropriate knowledge and resources available, then it is highly likely that the behaviour will be performed. Over time the positive feedback received from performing the behaviour will keep the behaviour going and will feed back into the individual's attitudes and self-belief, essentially becoming part of its own driving force. In contrast, it is possible that the behaviour has no benefit or no perceived benefit in which case the cycle would not be reinforced and the behaviour may stop. This is of concern with regard to pain alleviation as the benefits may not be easily recognisable or sufficiently tangible or measureable, to act as a positive reinforcement of the behaviour.

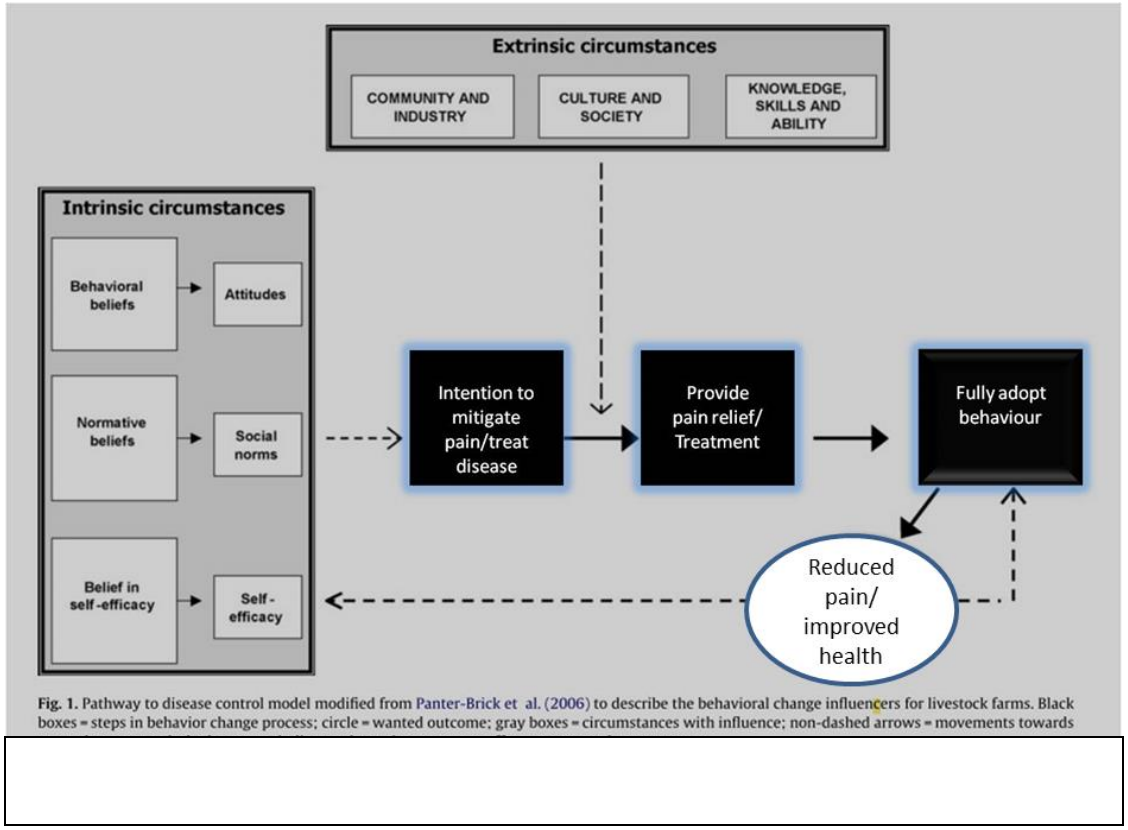

Figure 1.4 Pathway to pain provision and disease treatment model modified from Ellis – Iversen et al. (2010) to describe the behavioural change influencers for livestock farms.

= steps in behaviour change process.

= wanted outcome.

= circumstances with influence.

= movements towards wanted outcome

- - - - > = circumstances affect movement between steps

It is evident from Figure 1.4 that there are numerous points where the adoption or maintenance of behaviour may be compromised; these are called barriers, and may be real or perceived (Ajzen, 1991). For example, a lack of knowledge may be real or it may be perceived, potentially as a result of an individual believing a behaviour is more complex than it is. The role that external forces play within this scenario is of great importance too, as it is more difficult for an individual to adopt a behaviour if society or peers are against it. This has been shown to be a barrier in many aspects of life, particularly in the adoption of health behaviours such as low fats diets or giving up smoking (Armitage and Conner, 2001). The influence that social norms can have on an individual's behaviour can be a powerful motivating factor in behaviour change. An example of this is the use of environmental programmes employed by hotels to encourage guests to reuse their towels, therefore saving energy and reducing the amount of detergent related pollutants released into the environment. Research has found that the most effective method to encourage this pro-environmental behaviour is informing guests that the majority of previous guests had re-used their towels (Goldstein et al., 2008; Griskevicius et al., 2008).

9. Attitudes to Animals

An important element in understanding farmers' and vets' attitudes to pain and analgesic use in animals is likely to be their general attitudes to animals. Attitudes play an important role in the prediction and understanding of human behaviour (Ajzen, 1991). From an animal behaviour and welfare perspective, this relationship is of extreme importance when striving to improve animal welfare (Waiblinger et al., 2006). A range of disciplines are concerned with human attitudes and behaviours towards animals including: zoology, geography, socio-biology, psychology and veterinary science (Franklin, 1999).

The focus here will be to examine attitudinal research that has a bearing on understanding how individuals' attitudes influence how they interact with, and the management decisions they make, regarding the animals in their care The primary focus will be on the attitudes of farmers and vets, with research showing that negative attitudes towards animals can result in negative handling and reduced welfare (Hanna et al., 2009; Hemsworth et al., 1994). Attitudes can in turn be a positive motivating force for improvements in animal welfare legislation and policy (Serpell, 2004). The role that a farmer or vet plays in the life of a farm animal can vary between systems but it is always of significance with regard to the health and welfare of that animal. A wealth of research now exists on human-farm animal relationships, clearly showing the importance of positive personality, behaviour and attitudes of stockpersons for good animal welfare (see Rushen and de Passillé, 2015 for a review).

Understanding farmers' attitudes, and their decision-making processes is of importance due to the need to better understand farmers' motivations in order to develop and increase the uptake of practical and efficacious initiatives (Austin et al., 1998). From an animal welfare perspective it is of great importance that these motivation and decision-making processes are well understood so as to allow welfare scientists and policy makers to design welfare initiatives that are valid and practical and that farmers are in accord with.

9.1 Attitudes to pain and analgesic use in animals

The attitudes of caregivers towards animal pain are likely to affect how pain and disease are managed. The study of attitudes to animal welfare is a relatively new area of research, and as a consequence there is currently limited information available on the attitudes of farmers and veterinarians to aspects of welfare, such as pain management, in farmed animals. As noted above, the attitudes that individuals hold play an instrumental role in their behavior so the attitudes of farmers and veterinarians towards pain and disease in livestock will dictate how these issues are managed, with implications for the welfare outcomes of the animals concerned. The decision of whether to provide pain medications will in most cases be a joint assessment between farmer and vet and therefore requires both parties to be in accord. In recent years the number of studies in this area has increased, although the large majority of these studies have focused on veterinarians' attitudes to pain in cattle; information on other caretaker groups such as farmers and other livestock species remains limited.

Attitudes to animal pain and pain relief have improved in recent decades; one good example of this is a comparison between two Canadian studies. The original questionnaire study was conducted in 1994 (S E Dohoo and Dohoo, 1996) and a similar study subsequently conducted seven years later in 2001 (Hewson et al., 2006). The studies focused on veterinary treatment of dogs and cats. Pain ratings were higher in the second study, with an average mean increase of over 1 point (on a 10 point scale). The greatest increase in pain ratings was for ovariohysterectomy where scores increased from 4.1 for cats and 4.2 for dogs to 5.7 for both. In addition, the provision of postoperative pain relief had increased. For example, the percentage of cats and dogs receiving analgesics after an ovariohysterectomy increased from 17 to 43% for cats and from 13 to 47% for dogs between the two studies. For castration, the provision of postoperative analgesia increased from 9 to 30% for cats, and from 11 to 38% for dogs. The combined increase with all procedures for the provision of analgesia postoperatively was from 37 to 67% for cats and from 42 to 73% for dogs. The greatest increase was for dentistry, which went from 34 to 79% for cats and 32 to 76% for dogs. This demonstrates a large shift in attitude in the seven years between studies. However a substantial proportion of animals were still not receiving analgesia. To my knowledge no similar study has been conducted since, but if attitudes have continued to improve in the fourteen years since the second study it is plausible that analgesics are now routinely used in cats and dogs.

From these studies there appears to be a generally positive attitude to pain and analgesic use in cattle. With 98% of UK vets (Whay and Huxley, 2005), 100% of Finnish vets, (Raekallio et al., 2003), 96% of Scandinavian vets (Thomsen et al., 2010) and 94 and 99% of Danish farmers and vets respectively (Thomsen et al., 2012) agreeing that cattle benefit from pain alleviation. In addition, 91% of UK vets (Whay and Huxley, 2005), 82% of Finnish vets (Raekallio et al., 2003), 87 and 92% of Swiss farmers and vets respectively (Becker et al., 2013), 73% of Brazilian vets (Lorena et al., 2013) and 72 and 94% of UK pig farmers and vets respectively agree that analgesia leads to a better or faster recovery for the animal (Ison and Rutherford, 2014). These results show that the majority of farmers and vets who took part in these studies agree that animals benefit from, and recover better, when given analgesics as part of their treatment. However a proportion of participants also hold the belief that a degree of pain is beneficial to the animal as it limits activity. This varies considerably between studies, with up to 43% of Swiss farmers, 35% of Finnish vets and 10 and 16% of Danish farmers (Thomsen et al., 2012) and vets respectively agreeing. Sixty-eight percent of Brazilian vets disagreed that '*some degree of pain after surgery is good as it keeps the animal quiet*' (Lorena et al., 2013).

These studies indicate that overall farmers and vets view pain management as beneficial a number of studies indicate that much livestock pain goes unmanaged. Twelve percent of Canadian veterinarians said they never used analgesics (Hewson et al., 2006). Huxley and Whay (2006) found that 23 and 60% of vets didn't use pain medications for a difficult birth requiring assistance (dystocia, fetal-maternal disproportion requiring traction alone), in dams and calves respectively, 44% of vets didn't use pain medications as part of the treatment of ocular lesions (uvetis), and 25% of vets didn't use pain medications when castrating calves. In a study of Canadian vets (Hewson et al., 2007a) only 11% of veterinarians provided analgesia for piglet castration and not in all cases. This ultimately equated to 0.001% of piglets receiving analgesia, in spite of the fact that piglet castration had been given a mean pain score of 4.7 (out of 5). In the same study, less than 33% of vets always used, and more than 20% never used analgesia as part of the treatment of cattle lameness. Two recent UK studies on farm management had similar findings with 35% of cattle and 63% of sheep farmers saying they never used analgesics for the treatment of lame animals. This is interesting in light of the findings of a study on farmers' management of sheep lameness, where farmers reported that the two strongest motivators for them to treat lame animals were the desire to *'relieve their pain'* and to *'improve their welfare'* (King, 2013).

The seeking of veterinary attention can be of great importance for the welfare of a diseased animal. When asked to rank what factors were important when considering whether to seek veterinary attention for a diseased sheep (Clements et al., 2002), 76.8% of farmers put '*the degree of pain and discomfort experienced by the sheep*' first, followed by *'concern that other sheep will become infected'* (60.8%). The lowest ranking answer was 'the cost in labour and time should treatment be necessary' (12.8%). In addition respondents claimed to be no less likely to request veterinary attention for diseased sheep, as a result of the financial downturn in the UK sheep industry. The author points out that these results should be interpreted with caution as respondents may be inclined to provide the responses that they think are more socially acceptable. This appears to be the case here as data from the veterinary clinics that the surveyed farmers were clients of showed that veterinary attention was only requested for 2.2% of sheep with locomotion disorders, with farmers choosing to keep antibiotics on-farm instead (Clements et al., 2002).

9.2 Perceptions of pain in animals

A number of studies have looked at how farmers and vets rate the pain associated with a variety of conditions and procedures. The majority of studies have found that participants provided a very wide range of pain ratings demonstrating a lack of agreement on how painful certain conditions and procedures are for animals. For example, cattle practitioners showed a variation of between six and nine points on a ten point scale when rating the severity of a variety of procedures and conditions; castration with a rubber ring received scores of between one and ten and dehorning between two and ten (Huxley and Whay, 2006). This large variation in how pain is perceived may have significant welfare repercussions as an individual's rating of pain severity is likely to directly impact upon subsequent analgesic provision. Huxley and Whay (2006) found a significant difference between the pain ratings assigned by those who did and did not use analgesia, with higher pain ratings being assigned by those who did provide it. A similar finding was found in a study of Canadian vets on cattle dehorning. Those who used analgesia as part of the dehorning process rated dehorning pain higher (Hewson et al., 2007b). In a Canadian study of small animals, one of the main reasons vets said they did not use analgesics was because of their own perception of the pain experienced by the animal (S E Dohoo and Dohoo, 1996). In a study on farmers' views on pain in goats, it was found that having experience of a large number of conditions was negatively associated with overall pain rating, as was growing up on a goat farm (Muri and Valle, 2012). They also found a positive association between the attitude factor *'pleasant animals'* and pain ratings assigned by farmers to a number of conditions. The attitude factor 'pleasant animals' consisted of three statements pertaining to positive attitudes towards goats (e.g. 'goats are intelligent animals'); those who agreed most strongly with these statements also rated pain more highly. This is supported by research showing that a positive attitude towards a target is associated with increased empathic concern regarding the target's suffering (Hein et al 2010). Becker et al (2013) found that 82% of farmers agreed that if a cow does not perform a defensive movement during the treatment of a sole ulcer, then analgesia is not required. Only 42% of farmers thought the use of analgesia as part of the treatment of sole ulcers was reasonable. Farmers in similar studies have given a median pain score of 7

(Kielland et al., 2010) and 6 (out of 10) (Whay and Huxley, 2005) for sole ulcers. The overriding positive view that pain mitigation is beneficial, and that a number of procedures and conditions cause pain does not correlate with the relatively low rate of analgesic use evidenced in the previous section (7.1). These studies indicate that a discrepancy exists between peoples' attitudes and their behaviour.

How farmers and veterinarians rate the importance of 'freedom from pain' is vital for good animal welfare. If it is perceived as a low priority progress in improved pain management will be hindered. A study looked at how farmers and veterinarians perceived the importance of thirteen different welfare issues that affect sheep. The overall ranked importance was: parasite control, mulesing, shelter, stockmanship, tail docking, ground transport, feeding, predation, pre-slaughter stunning, castration, curfew (pre-transport food and water deprivation), sea transport and mustering. Three of these welfare issues are considered painful husbandry procedures (Graham et al., 1997; Grant, 2004; Kent et al., 1998) involving the removal of tissue: mulesing, tail docking and castration, ranked second, fifth and tenth respectively. This study highlights that the perceived importance of 'pain' as a welfare concern is dependent upon its cause and severity.

9.3 The relationship between gender, age and attitudes

Many studies have found effects of gender and age on attitudes to animal welfare (Austin et al., 2005; Paul and Podberscek, 2000; Serpell, 2005), pain ratings (Susan E Dohoo and Dohoo, 1996; Ison and Rutherford, 2014; Laven et al., 2009; Raekallio et al., 2003) and analgesic provision (Susan E Dohoo and Dohoo, 1996). Within the veterinary profession younger vets have been found to rate pain higher and provide more pain relief than older vets (Raekallio et al. 2003; Huxley and Whay 2006; Laven et al. 2009; Lorena et al., 2013). It is difficult to say with certainty why this difference exists between young and old vets. Paul and Podberscek (2000) found that the level of sentience attributed by vet students to dogs, cats and cows was lower in later years of the course. The authors suggest that this change is attributed to a degree of emotional 'hardening' or 'detachment' that takes place during veterinary education, a phenomenon similar to that reported within medical training as practitioners become desensitised to emotion provoking stimuli (Newton et al., 2008) Therefore, the difference seen between young and old vets could also be attributed to this 'hardening' process. It could also be explained by an increased focus on welfare and pain management that now occurs during veterinary teaching, with more recently qualified vets having more knowledge and awareness of these issues. An alternative explanation may be the increased numbers of females entering the veterinary profession over the last two decades; the average age of female vets is 37.5 compared to 51 for males, with 63% of female vets being under the age of 40, in comparison to only 28% of male vets

(Buzzeo et al., 2014). Females have been found to have more positive attitudes towards animals, rate pain higher and are more likely to provide analgesia than males (Capner et al., 1999; Hugonnard et al., 2004; Huxley and Whay, 2006; Lascelles et al., 1999; Laven et al., 2009; Lorena et al., 2013; Raekallio et al., 2003). Female veterinary students rated cattle pain higher than did males (Kielland et al., 2009) and female agriculture students were found to have more positive attitudes to animal welfare than male agriculture students (Austin et al., 2005). Serpell (2005) found that gender was the most significant predictor of humane attitudes to animals, with female vet students having more positive attitudes than males. In addition female vet students were shown to maintain their level of affective empathy (the ability to share in the emotions of another) over the duration of their studies, whereas males showed lower levels of empathy in later years (Paul and Podberscek, 2000).

9.4 Empathy & compassion towards animals

The fact that the term 'empathy' only entered the English language in the 20th century may explain some of the inconsistencies with its use and definition (Pommier, 2010). Empathy is defined here as '*the ability to discern or vicariously experience the emotional state of another*' (Jimenez, 2009 p.210), therefore consisting of both a cognitive and emotional element. Compassion however is '*being moved by the suffering of others such that one desires to relieve or make bearable that suffering*' (Jimenez, 2009 p.209). Ekman (2010) discusses these psychological constructs as separate components of one psychological phenomenon. The first component, *emotional recognition* is believed to have an innate basis in humans. *Emotional recognition,* also commonly referred to as *cognitive empathy,* is the ability to recognise another's mental state, and be conscious of how another is feeling. The second component *emotional resonance,* also commonly referred to as a*ffective empathy* is when someone shares the emotions of another or is emotionally moved by another's emotion. The third component, *compassionate empathy,* is when someone's suffering moves another to help. Cognitive empathy must be present in order to achieve either of the other forms of empathy, but compassionate empathy can occur without the presence of affective empathy, i.e. one does not need to have an emotional response to something to have the desire to help (Ekman, 2003). Therefore compassion may play an important role in an individual's decision to provide pain relief or change management practices to negate the need for painful husbandry procedures. Throughout this thesis these three constructs will be discussed as cognitive empathy; affective empathy and compassion. The rationale for studying empathy towards animals is that the ability to at least recognise the feelings of another is paramount to achieving good animal welfare. A farmer that recognises suffering in an animal and is motivated to alleviate it will ultimately have animals with better welfare than one who does not.

There is a growing body of evidence that suggests that the neural processes involved in the direct experience of pain are also involved in empathy for pain in others (see Decety, 2010; Lamm et al., 2011 for reviews). In fact recent research has demonstrated that pain empathy may also be modulated by placebo analgesia to a similar extent as actual pain (Rutgen et al., 2015). Therefore evidence suggests that empathy is a key component of pain perception in others.

One of the first studies to attempt to measure animal-oriented empathy was Paul (2000). Paul adapted a well utilised measurement tool for human-oriented empathy, the Questionnaire Measure of Emotional Empathy (QMEE) (Mehrabian and Epstein, 1972) and modified it to create the Animal Empathy Scale (AES). The results provided evidence that human- and animal-orientated empathy were positively correlated. However the results were equivocal and suggest that although they are related, human- and animal-oriented empathy are different. This then raises the issue that human-directed empathy tools may not be suitable if one is interested in the effect of empathy on human behaviour concerning animals. There are mixed findings regarding the impact empathy has on the human-animal relationship and whether it is an important component in how stockpersons view and treat the animals in their care. This may be in part because empathy as a psychological construct cannot be directly measured, and relies on the use of proxy measures (Boyle et al., 2015). It may also be as a result of the variety of measurement tools used, which in reality may be measuring different psychological constructs.

Only a small number of studies have investigated farmer empathy. Coleman and Hemsworth (1998) was one of the first studies to investigate the relationship between empathy and stockperson behaviour. They also developed a modified version of the QMEE, which contained both human and pig focused items, but this empathy scale did not correlate with stockperson behaviour. Two studies investigated the relationship between dairy cattle farmers' levels of empathy, personality traits (Hanna et al., 2009) and welfare indicators in their cattle (Kielland et al., 2009). The latter used a series of photographs depicting cattle affected by a number of painful conditions designed to elicit an empathetic response. This empathetic response was measured in the form of pain scoring on a visual analogue scale from no pain to unbearable pain. Only two significant welfare indicator outcomes were found, farmers who rated pain highly had i) cows with the lowest number of skin lesions over their carpus and ii) the lowest milk yield. Hanna et al. (2009) developed a novel empathy scale consisting of a series of statements pertaining to cognitive, affective and compassionate empathy. A positive relationship was found between empathy scores and milk yield, and between empathy scores and farmer personality traits for agreeableness, conscientiousness and intellect.

These conflicting results of the relationship between empathy and milk yield from these two studies suggest that the tools used (i.e. photographs of painful conditions and statements pertaining to empathetic feeling) are not measuring the same thing. This is perhaps further highlighted by the results of a Norwegian study investigating goat farmer empathy and their assessment of pain (Muri et al., 2012). This study adapted a subscale of Paul's (2000) AES so it was goat specific. As well as completing this empathy test farmers were also asked to rate how painful they believed a number of conditions were for goats. No relationship was found between the empathy measure and pain ratings. These results demonstrate variation in the effects of empathy found, which may indicate that the various tools being used are not measuring the same construct (i.e. empathy) and therefore there is a need for validation of these methods.

Why this difference between men and women in their empathetic tendencies exists is not fully understood, but may be partly explained by biological differences in fetal development. During fetal development males are exposed to substantially greater levels of testosterone than females. A study, investigating the relationship between amniotic measures of fetal testosterone and empathy measures, conducted when the children were six to eight years old, found a significant negative correlation between the two (Chapman et al., 2006). Subsequent research found that the provision of testosterone to adult women reduced their ability to empathise (van Honk et al., 2011).

Other hormones have also been implicated in empathetic tendencies. Oxytocin, sometimes referred to as the love hormone, because of its role in social bonding, intimacy, and child birth has been associated with the ability to recognise facial expressions of emotion in others (Van IJzendoorn and Bakermans-Kranenburg, 2012). The provision of oxytocin to human test subjects resulted in greater empathetic responses to images of other people experiencing a painful event (Abu-Akel et al., 2014).

9.5 Sentience & speciesism

The human-animal relationship is a complicated one; as pet ownership has increased so has meat consumption (Loughnan et al., 2014). How we decide which animals are worthy of moral consideration is of great interest to anthrozoologists. Within the animal kingdom distinctions are made between different groups, assigning some groups or species more rights. For example, people who keep a pet are more likely to assign greater mental attributes to that species than people who do not, which has been attributed to familiarity (Morris et al., 2012). We are also more likely to assign greater mental attributes, or defend greater concern for animals we find attractive, compared to animals that we find physically unappealing (Herzog and S, 1997; Knight and Barnett, 2008).

In addition, we are more likely to attribute human-like conscious abilities to animals that are more similar to ourselves than to phylogenetically more distant species even when identical behaviour is displayed (Mendl, 2004). It appears that this phenomenon also extends to emotional capacity, with a number of studies finding that chickens are viewed as less capable of experiencing emotions (sentience) than mammals, and fish less so than chickens (Heleski et al., 2004; Izmirli et al., 2012; Levine et al., 2005; Phillips and McCulloch, 2005). The extent to which people believe that different species are sentient and capable of experiencing pain will have implications for animal welfare. The perceived capacity of a species to experience pain may directly relate to the degree of moral concern that species inspires (Loughnan et al., 2014). Research has also found a difference in how the sentience of companion and livestock species is perceived, for example dogs were viewed as more sentient than pigs (Phillips and McCulloch, 2005). Somewhat worryingly is the finding that 24% of Finnish veterinarians either agreed or did not know whether farm animals were as sensitive to pain as companion animals (Raekallio et al., 2003). Furthermore, a mean agreement score of 4.8 (out of 5) was found for Finnish cattle vets level of agreement with the statement that *'production animals are as sensitive to pain as pets'* (Norring et al., 2014a). This evidence suggests that a perception does exist whereby animals farmed for food are perceived as having a lower capacity to experience pain than those kept as pets. This is further supported by the findings of a study where participants were asked to what degree an unfamiliar animal (tree kangaroo) was capable of feeling pain. Those who were told that locals ate this species rated its pain capacity lower than those who were not given this information (Bratanova et al., 2011). Furthermore, research suggests that humans who eat meat navigate the potential moral dilemma of doing so by modifying their beliefs about the mental capacity of production animals, including their capacity to feel pain (Loughnan et al., 2014). The authors found that participants reported greater moral concern for animals and rated a cow's capacity to suffer as greater after they had eaten a non-meat item (cashew nuts) compared to when they had eaten a meat item (beef jerky) (Loughnan et al., 2010).

10. Identifying Pain & Implications for Pain Management

Identifying pain in different species is complex and requires species-specific knowledge of animal behaviour, experience of working with animals and the opportunity to observe behaviour. The amount of contact a stockperson has with his animals will vary depending on the type of farm; therefore the likelihood of problems being identified, diagnosed and treated varies between systems. Distance from the animals, size of the terrain and the management system used by the farmer will dictate how often each animal is directly assessed. For example, dairy cows will be brought in daily for milking whereas hill sheep may be gathered as little as twice a year (Dwyer, 2009). Dairy cows are milked at least twice a day and are therefore routinely seen by farm staff. In spite of this dairy cattle are estimated to have the highest lameness prevalence of all farmed species with average prevalence estimates in the UK of 16% (Rutherford et al., 2009), 21% (Clarkson et al., 1996) and 36% (Barker et al., 2010). This consistently high lameness prevalence is likely being driven by farmers' underestimation of lameness in their herd, with studies showing that farmers only identified around 25% (Whay et al., 2003) and 50% (Rutherford et al., 2009) of lame cows than when assessed using a locomotion scoring system. In addition, farmers' estimates of lameness were not reflected in the treatment records, suggesting that not all treated cases were recorded and/or some observed cases were not treated (Whay et al., 2003). This example of dairy cow lameness shows that a large percentage of lame cows are not being identified and are therefore going untreated.

10.1. Behavioural indicators of pain

Attitudinal studies of farmers and veterinarians have come across the issue of the apparent lack of behavioural indicators of pain, for example 40% of Finnish cattle vets (Raekallio et al., 2003) and 20 and 21% of British pig farmers and vets (Ison and Rutherford, 2014) respectively agreed that it was difficult to recognise pain in animals. A perceived lack of behaviour change on the part of the animal is likely to result in the underestimation of pain. It is possible that because animals are not displaying the behaviour expected after experiencing pain, they are therefore not actually suffering. This mind set puts the onus on the animal for not communicating its pain better, rather than on the human for not being proficient in recognising the signs that the animal is giving. For example a cat owner may not recognise their cat is in pain from a broken limb as the cat will hide away rather than vocalise its pain (Taylor, 1985). Therefore knowing species-specific pain behaviours is essential to providing appropriate care.

An example of the importance of human perception of animal pain is piglet castration. In 2002 Norway introduced new piglet castration regulations. The procedure is only to be performed by a veterinarian and with the use of local anaesthesia (Fredriksen and Nafstad, 2006) which has been shown to significantly reduce nociception in various areas including the spermatic cord (Fredriksen and Nafstad, 2006) believed to be the main source of pain during castration (Taylor and Weary, 2000). Two years after the new regulations were implemented an attitudinal study was conducted. Both veterinarians and pig producers were questioned regarding the provision of anaesthesia, over 50% of veterinarians felt that it improved animal welfare, in comparison to only 19% of farmers. Fredrikens and Nafstad (2006) postulate that this lack of positive attitude was as a result of the fact that piglets scream when handled regardless of whether they are in pain or not. Although piglets routinely scream when handled, castrated piglets produce more high frequency calls compared to sham-castrated piglets (Weary et al., 1998) and when anaesthetics are provided, piglets have significantly fewer high frequency calls than piglets who were castrated without anaesthetic (White et al., 1995). In addition piglets show behavioural changes such as an increased time spent sitting or standing inactive, and a decreased time lying (Taylor et al., 2001). The belief by the farmers surveyed, that the provision of anaesthetics did not increase the piglet's welfare, is likely to have come about for a combination of reasons. Firstly, the farmers had an initial negative attitude towards the provision of anaesthetic. Secondly, piglets scream regardless of whether they have received anaesthesia or not, making it more difficult to accept that the anaesthesia is improving the situation for the piglet. Thirdly, the subsequent behavioural changes that occur are unlikely to be witnessed by the farmer who will have moved on to the next litter. Or if they are witnessed, they may not be accepted as sufficient evidence of the piglets' pain. In addition there is the belief that the increased amount of handling required for local anaesthetic provision will cause increased stress to the animal that outweighs the benefits of the anaesthesia.

Much work has been conducted on behavioural indicators of pain in lambs. One study looked at behaviour change as a result of a variety of procedures: castration, tail docking, ear tagging, and mulesing (Grant, 2004). They found rubber ring castrated and tail docked lambs engaged in significantly extended periods of abnormal postures and pain behaviours than both control lambs and those who were hot iron tail docked. Kent et al. (2000) and Molony et al. (2012) found similar behavioural changes including a significant increase in the mean frequency of foot stamping, kicking, tail wagging and head turning to the scrotum and inside hind leg in lambs castrated without anaesthetic than those who had been castrated with anaesthetic. Work on castration pain in calves found a significantly increased incidence of licking of the castration site, increased abnormal standing, alternative lifting of the hind legs and head turning (Molony et al., 1995), and a similar increase in pain related behaviours is seen after disbudding calves (Stilwell et al., 2008). A study conducted on disbudding in kids showed a marked increase (100%) in the amount of time they spent struggling and in the intensity of their vocalisations during the procedure than did those who experienced a sham disbudding (Alvarez et al., 2009).

This perceived lack of notable behaviour change in animals is considered by some to be a sign that animals are not experiencing pain or that their pain experience is minor. However countless studies have shown these behaviour changes do occur in a huge variety of species affected by pain. Recognising animal pain and being able to estimate its severity is reliant on an ability to appreciate and recognise pain behaviours which will vary between species, individuals and the cause of pain.

11. Veterinary Drugs

The treatment of disease and pain often require veterinary medicine. The use of pain relief, however, is not always straightforward, and various issues regarding this can act as a barrier. Firstly, there may be concerns with regard to side-effects. Sixty and 37% of Brazilian vets (Lorena et al., 2013) considered the side-effects of non-steroidal anti-inflammatory drugs (NSAIDs, an analgesic) to be an important consideration for use in horses and cattle respectively. The most important side-effects were considered to be gastric adverse effects (91%) and nephrotoxicity for horses (40%) and cattle (70%). Thirty-eight percent of Finnish vets (Raekallio et al., 2003) agreed that side-effects limit the usefulness of analgesics compared to only 10% of Scandinavian (Denmark, Norway, Sweden) (Thomsen et al., 2010) and Brazilian vets (Lorena et al., 2013), and 5% of British vets (Whay and Huxley, 2005) and Danish farmers and vets (Thomsen et al., 2012). Secondly there are regulations surrounding the storage and administration of certain medicines, as well as potential issues with availability. Some drugs have specific regulations regarding storage and record-keeping, not all drugs are easily available and some can only be administered by a veterinarian. Specifically there are no licenced analgesics for some species, for example, sheep. Analgesics can be given under the 'cascade' system that allows the use of drugs licensed in one food animal to be used in another food animal species. However when the cascade system is used, withdrawal time increases and dosage can become unclear. Thirty-seven per cent of UK cattle vets agreed that E.U legislation limited their ability to use analgesics (Whay and Huxley, 2005).

12. Experience & Knowledge of Pain

How important an individual's experience of specific painful conditions or procedures with regards to pain assessment in animals is unclear. Research has found instances where experience of a particular condition resulted in a lowered pain perception. Cattle farmers rated the pain associated with bovine uveitis (eye infection) - a rare condition -

higher than did vets who were likely to have had more experience of the condition than farmers. This is a similar finding to that of a comparison of New Zealand and UK cattle vets, were New Zealand vets gave a higher pain score to the unfamiliar condition of a displaced abomasum (stomach) than did UK vets who were more familiar with this particular condition. These examples indicate that experience of a condition actually reduces the perceived severity. A study of goat farmers found that having experience of a large number of conditions was negatively associated with farmers' pain perception ratings (Muri et al., 2012). The authors suggest that a similar process occurs for animal pain assessment as human pain assessment, where clinicians' perception of the pain experienced by a patient is lower when the clinician is experienced (Cheng et al., 2007). Cheng and colleagues present research that shows differences in the neural processing of painful stimulus in others between naive and experienced clinicians. They argue this is an adaption that reduces personal distress in clinicians which may otherwise interfere with their ability to treat the patient. However the results from the goat study are in contrast to a study of dairy farmers, where farmers with personal experience of a particular conditions rated pain higher (Kielland et al., 2010).

A number of studies on veterinarians' attitudes to animal pain have found that the majority of respondents felt that their pain knowledge was learnt on the job (Dohoo and Dohoo, 1996; Jackson et al., 2006; Lascelles et al., 1999; Whay and Huxley, 2005;

Whay et al., 2008). Only 50% (Hewson et al., 2006) and 58% of small animal vets (Williams et al., 2005), 46% of cattle vets (Whay and Huxley, 2005; Whay et al., 2008) and 37% of pig vets (Ison and Rutherford, 2014) considered their ability to assess and treat animal pain to be adequate. This is a cause for concern, especially since, as Whay and Huxley (2005) point out, veterinary practice can be very insular, with a high degree of lone working, and as such there is likely to be large variation in opinions and practices. Without standardised training methods, much animal pain is likely to be unidentified and therefore remain untreated. Furthermore, Whay and Huxley (2005) found that when veterinarians were asked to list what analgesic drugs they had available at their practice; they included drugs that have no analgesic properties. Similarly, it is likely that the knowledge that farmers have of animal pain is gained from their own experience, or is learnt from fellow farmers, family members or their vet. Although learning from experience is important, their pain assessment skills may be greatly lacking in accuracy. As a result they may be missing behavioural signs of pain that their animals are showing. Two studies of British farmers found that 62% of cattle farmers (Huxley and Whay, 2007) and 48% of pig farmers (Ison and Rutherford, 2014) agreed that they did not know enough about controlling pain. Whilst 53% of cattle farmers said that their vets did not discuss pain control with them enough, and only 30% of pig farmers agreed that they regularly discussed pain relief options with their vet. A finding of possible note is the difference seen between vets in their own assessment of their knowledge. Seventy-five percent of Canadian large animal vets

(Hewson et al., 2007a) considered their knowledge of pain to be appropriate, in comparison to only 16% of Brazilian vets (Lorena et al., 2013), in spite of the fact that their use of analgesics was similar.

13. Economics, Time & Labour

Ensuring high levels of animal welfare may require additional time and resources on the part of the care giver and could therefore be considered labour intensive (FAWC, 2011b). For most farmers this means investing even more of their time. For other farmers it is the difficulty in finding and the expense of labour that is the issue (Dwyer, 2009). In addition, the cost of pain relief is commonly cited as being one of the main reasons farm animal pain is not more appropriately managed. Research has found mixed views on this. Becker et al. (2013) found that 47% of vets believed that cost was a major concern for farmers when considering the use of analgesia, however only 11% of farmers agreed. In the same study 61% of vets and 74% of farmers agreed that farmers were willing to pay the cost of analgesia. In Whay and Huxley (2005) 65% of vets agreed that cost was likely to be an issue for farmers, but a subsequent farmer study suggests this may not be the case (Huxley and Whay, 2007). Cost was also considered a barrier for the treatment of pig pain with 44% of farmers and 48% of vets agreeing that analgesia was too expensive to use regularly (Ison and Rutherford, 2014), and 56% of Brazilian vets considered cost to be an important factor in their decision to use NSAIDS to treat pain in cattle (Lorena et al., 2013). These results indicate that vets perceive a lack of willingness on the part of the farmers to pay for analgesics. The cost of providing pain relief is even greater as often farmers have to pay their veterinarian to administer the drugs, something that will be economically less feasible on small-scale farms (de Roest et al., 2009). Allowing farmers to administer anaesthetics and analgesics may make it more financially practical. However welfare concerns regarding proper technique and appropriate administration are likely. It would be necessary for farmers to undergo training on the safe use of these drugs which has the potential to generate concerns about the feasibility of the practice.

14. Additional Barriers

The barriers detailed above: attitudes, knowledge, economics, time and labour and issues concerning veterinary drug use were the barriers detailed in the literature. In reality there will be more barriers, both perceived and actual. Issues such as tradition are often referred to within the farming industry as a 'barrier to change'. Although I found no detailed reference to tradition and pain within the literature it is likely tradition will be present as a barrier. This barrier could manifest itself both as physical tradition whereby specific techniques are used because traditionally that is how things were done, or attitudinal tradition whereby animal pain was not considered or pain was just an accepted part of farm life.

15. Conclusion

Freedom from pain is a basic requirement for good welfare; however pain is routinely experienced across farmed species and frequently left unmitigated. In order to improve animal welfare, practices need to change, whether that is by the cessation of painful procedures, or appropriate pain mitigation. Attitudinal barriers exist both at an individual and societal level. Changing these attitudes and encouraging better practice is crucial to improving animal welfare through the mitigation of pain. The literature has identified a number of key areas where improvements could be made: improving communication between farmers and vets, improved pain assessment and education on the use, availability and benefits of analgesics. Understanding the attitudes of farmers and vets and developing strategies to break down barriers will be an important step in improving pain management.

The following thesis presents the results of four separate studies, that were conducted to assess the attitudes of sheep farmers and veterinarians, towards pain and the use of pain relieving drugs in sheep. Although a number of similar studies have been carried out previously, these have almost exclusively investigated the views of cattle vets, resulting in an underrepresentation of the views of farmers. When one considers that farmers are in fact the ones solely responsible for the daily care of his/her animals this imbalance warrants addressing. Additionally, the large focus of previous research has been on cattle, with few studies investigating attitudes towards pain in sheep.

Considering that within the UK, sheep are the most dominant of our large farmed animals with 23 million heads, compared to 10 million cattle (DEFRA, 2014) this absence of literature is perhaps surprising. Globally, sheep numbers are estimated at around 1.2 billion, just under the 1.4 billion cattle farmed annually (FAO, 2013). Sheep are therefore an extremely prolific and economically important species across the world. Understanding how farmers and vets perceive pain in these animals and their attitudes towards the prevention and treatment of pain will have significant implications for their welfare. When considering the degree to which animal welfare may be compromised it is important to consider not just the impact a situation may have on the welfare of individual animals, but also the numbers of animals that may be affected. FAWC considers *'that the more animals which are affected, the more serious is the problem'* (FAWC, 2008).

Chapter 2 Farmers’ attitudes to pain in livestock

Abstract

A study of UK cattle and sheep farmers was conducted in order to investigate: i) farmers' views on the importance of various aspects of animal welfare; ii) farmers' attitudes to pain and analgesic use and whether there was a relationship between these attitudes and how they rated the pain associated with different conditions and procedures; iii) whether farmers perceived there to be a difference in the capacity of different species to feel pain. Responses to 10 attitude statements concerning pain and the use of analgesia in livestock were analysed using principal component analysis. This revealed one strong attitude dimension with high internal reliability as assessed by Cronbach's alpha, allowing for the calculation of a single factor regression score for each participant. Analysis releveled that cattle farmers scored higher on this attitude dimension than did sheep farmers ($p<0.001$). Difficult lambing and calving were rated as the most painful conditions with mean ratings of 4.1 and 4.0 (out of 5) respectively. Normal lambing and calving were among the least painful, with means of 2.7 and 2.8 respectively. Ear marking and tail docking were also among the least painful with mean scores of 2.3 and 2.9 respectively for sheep, and 2.4 and 3.1 respectively for cattle. Farmers rated sheep and cattle as having similar capacities to feel pain, with these species being significantly below the ratings assigned to humans, and above the ratings assigned to turkeys ($p<0.001$). Ninety three percent of farmers agreed that farm animals benefit from pain alleviation; 4% agreed that analgesia wasn't necessary for farm animals; 82% agreed that animals recover better when given analgesia. Farmers were

asked to score how acceptable it was for animals to experience a range of welfare compromises based on the Five Freedoms welfare framework. Farmers scored prompt treatment of disease and the provision of pain relief the most important welfare considerations ($p<0.001$). Overall these results indicate that farmers believe that animals can experience pain and that managing pain can be beneficial for the animal.

1. Introduction

The Five Freedoms welfare framework states the importance of both physical and mental wellbeing for good animal welfare (FAWC, 2009). However the Five Freedoms is a conceptual ideal and it may be impossible to ensure all of the Freedoms all of the time. For example, in the livestock industry there is often a conflict between the Freedom to express normal behaviour and the Freedom from hunger or thirst. Extensively reared animals are often perceived as having greater welfare than intensively reared animals as they have more behavioural freedom and are viewed as having a more natural life (Dwyer, 2009). However there is a greater risk to animals in extensive systems of not receiving treatment for an injury or disease due to lower levels of contact between the animals and stockpersons (Dwyer, 2009). Therefore the system in which animals are kept will dictate to some degree what welfare compromises they are likely to be exposed to. Understanding how farmers view these trade-offs may be important for the welfare of the animals in their care.

Livestock may experience a number of painful events during their life. For example lambs are routinely tail docked and castrated within a few weeks of birth (FAWC, 2008); 6 to 9 million sheep are likely to become lame every year (FAWC, 2011a); and breeding females may experience pain during parturition (Mainau and Manteca, 2011). The provision of analgesia will depend upon the caretakers' perception of the pain, the condition or procedure in question and the species of animal. Two Canadian studies investigating veterinarians' use of analgesia in livestock and in companion animals found a significant difference between species in post-operative analgesia provision for castration. Thirty and 38% of cats and dogs (Hewson et al 2006) received analgesia respectively, whilst 20% of cattle and 0.001% of pigs did (Hewson et al 2007). This was in spite of similar median castration pain scores being assigned for all species: 4.1 - 5 (out of 10). Philips et al. (2009) conducted a study of farmers' and veterinarians' views on the importance of different welfare concerns. Participants who worked with sheep and/or goats rated tail docking and castration as the 5th and 10th most important welfare issue respectively (out of a list of 13 items). This difference is likely due to the fact that castration is viewed as more painful than tail docking, as was found in a study of sheep farmers views on welfare, where tail docking and castration received median pain scores of 3 and 5 (out of 10) respectively (Dwyer, 2009). This view that castration is more painful than tail docking is supported by scientific evidence (Molony et al., 2002).

A relationship has been found between attitudes towards animals and human-animal interactions in a number of studies, with negative attitudes having implications for welfare (Hemsworth et al., 1993; Rushen and de Passillé, 2015). The attitudes of people towards pain and the use of analgesia may influence their pain rating, and their subsequent treatment decisions surrounding pain. In a study of dairy farmers' attitudes to animal welfare (Kielland et al., 2010) the likelihood that a farmer would agree with the statement '*animals experience physical pain as humans do*' was greater when the farmer had given a higher median pain score. Another study, on attitudes to disbudding pain in dairy cattle, found a positive association between Finnish farmers' attitudes to disbudding and their attitudes to the pain associated with a number of cattle diseases (Wikman et al. 2013). It is probable that people with more positive attitudes towards pain in animals will be more likely to treat pain. Therefore the aims of this current study were to understand how farmers viewed pain and analgesic use in livestock and how they perceived the pain associated with common procedures and conditions. A number of studies have investigated attitudes towards and perceptions of pain in cattle but to our knowledge this is the first time this has been done in sheep, and therefore the first time that a direct comparison has been made between these two groups of livestock farmers.

Research questions:

i Do farmers view the acceptability of different potential welfare compromises differently?

ii Do farmers perceive there to be a difference in the capacity of different species to feel pain?

iii What are farmers’ attitudes to pain and analgesic use?

iv Is there a relationship between farmers’ attitudes to pain and analgesic use and how farmers rate the pain associated with different conditions and procedures?

2. Methods

2.1 Design Overview

Sheep and cattle farmers completed a paper-based questionnaire on their views of pain in production animals. There were two versions of the questionnaire; one for sheep farmers and one for cattle farmers. Each questionnaire was four pages long and consisted of six sections containing questions relating to: pain rating for different conditions and procedures, the Five Freedoms, capacity of different species to feel pain, attitudes to pain, and farm and farmer demographics. The two questionnaires were identical with the exception of the pain rating questions where there was some species-specific variation in the conditions and procedures presented. Between group comparisons (types of farmers) and within group associations were tested to answer the research questions. The questionnaire received internal ethical approval from the School of Health in Social Science at the University of Edinburgh. The questionnaires are included in Appendix I (sheep) and II (cattle).

2.2 Sample and Recruitment

The data were collected between June and December 2013. Multiple sampling methods were utilised for data collection, including: a large scale postal distribution (n=592), face to face recruitment at agricultural shows (n=165), recruitment by staff from the National Farmers Union of Scotland (n=84) and by veterinary consultants from Scotland's Rural College (n=11). The postal distribution was achieved using contact details of a random sample of 1,000 beef and 1,000 sheep farmers from England, Wales and Northern Ireland obtained from GH publishing the publishers of Farm Business. The sample was proportionally stratified by region and herd/flock size with a minimum herd size of 30 or flock size of 100. The questionnaire was sent, along with a reply-paid envelope and a letter detailing the premise of the research. Those who took part at an agricultural show were given the option to be entered into a prize draw to win a £25 voucher or a bottle of whisky, with one prize available for each day of each show. Those who were recruited by post were given the option to be entered into a prize draw to win a £100 voucher, with one prize available for sheep farmers and one available for cattle farmers.

2.3 Questionnaire

An online version of the questionnaire was piloted by members of the Rare Breeds Survival Trust in the process of developing and refining the questionnaire.

2.3.1 Demographics

Personal and farm demographic information was gathered on participants, including: age, gender, country of residence, number of years' experience working with sheep/cattle, number of ewes/cattle currently working with, type of production: sheep (hill, upland, lowland) cattle (dairy, beef).

2.3.2. Freedoms

A novel attitude tool was developed utilising the Five Freedoms welfare framework to assess how farmers viewed the importance of a number of welfare requirements. Participants were asked to rate how acceptable it was for farm animals to sometimes be denied each of the Five Freedoms (Table 2.1). The 'freedom from pain, injury or disease by prevention or rapid diagnosis and treatment' was split into two questions, one pertaining to prompt treatment and one to the provision of pain relief to animals in pain. These questions were answered on a 100mm visual analogue scale (VAS) with anchors at either end of the scale, '*strongly agree*' and '*strongly disagree*'. Participants were asked to place a downward line through each of the scales at the point they felt best represented their level of agreement with the six different statements. Therefore answers towards the 'strongly disagree' end of the scale represented positive attitudes towards that Freedom.

Table 2.1 Welfare statements based on the Five Freedoms

It is acceptable if farm animals are sometimes hungry
It is acceptable if farm animals sometimes don't have shelter and a comfortable resting area
It is acceptable if sick farm animals are not always treated promptly
It is acceptable if farm animals in pain are not always given pain relief
It is acceptable if farm animals are not always able to express normal behaviour
It is acceptable if farm animals sometimes experience fear or distress

2.3.3 Capacity to feel pain

Participants were asked to rate different species (humans, cattle, sheep, and turkeys) in their capacity to feel pain on a 100mm VAS with anchors at either end: 'Feels no pain' and 'Capacity to feel the worst pain'. Participants were asked to place a downward line through each of the scales at the point they felt best represented each species capacity to feel pain. Previous studies have used a similar approach to assess peoples' views on animal sentience.

2.3.4 Attitudes to pain

Participants were asked to rate their level of agreement to ten statements about pain in farm animals on a 5 point Likert scale: '*Strongly agree*', *'Agree', 'Neither agree nor disagree', 'Disagree', Strongly disagree'*. The statements used were chosen to cover a range of commonly cited reasons why analgesic use is not commonplace, these included cost, management practices and general attitudes towards pain and analgesic use. Five of these statements were based on statements that had been used in previous studies investigating attitudes to pain in cattle (Table 2.2). An additional five novel statements were developed including three pertaining to management practices and two additional general attitude statements (Table 2.9).

Table 2.2 Attitude statements adapted from the literature

Statements	Studies
Farm animals benefit from pain alleviation	Raekallio et al. 2003; Whay and Huxley 2005 Thomsen et al. 2010; Thomsen et al. 2012.
Farm animals recover better from an injury, disease or painful procedures when given pain relief drugs	Raekallio et al. 2003; Whay and Huxley 2005
Some degree of pain is beneficial to the animal	Raekallio et al. 2003; Thomsen et al. 2012
Pain relief drugs are too expensive to use regularly	Whay and Huxley 2005
In general I am happy to pay the cost involved with giving pain relieving drugs	Whay and Huxley 2005

2.3.5 Pain Rating

Participants were asked to rate their own ability to assess and control pain using multiple choice options: '*Excellent*', '*Very good*', '*Good*', '*Fair*', '*Poor*', '*Very poor*' and '*No ability*'. In addition participants were asked to rate how painful a number of conditions and procedures were for sheep or cattle: '*No pain*', '*Mild pain*', '*Moderate pain*', '*Severe pain*', and '*Worst pain*'. A '*Don't know*' option was also provided for all the questions in this section. 'Don't know' responses were re-coded as missing values prior to statistical analysis.

3. Data & Statistical Analysis

3.1 Data

Responses were manually inputted into Excel. Using an online random number generator, a 10% sample of questionnaires were chosen for cross-checking to ensure data input was accurate. Data for the VAS questions were extracted by measuring the distance from the left end of the scale to where the participants had placed their mark.

3.2 Analysis

Statistical analyses were carried out in Genstat (16^{th} Edition) (REML) and SPSS (22^{nd} Edition) (principal component analysis (PCA) and ordinal regression). Main effects were considered significant at $p<0.05$ and interactions at $p<0.01$. REML was utilised for statistical analysis as it does not require a balanced design and has the capacity to fit both random and fixed effects in the model. All possible interactions between fixed effects were investigated by running multiple iterations of the model. Non-significant interactions were removed and the model re-run until the simplest model was achieved, i.e. only the main effects and significant interactions remained. Normality of the data was assessed by inspection of the residuals. Post hoc analyses were conducted using least significant difference (LSD) tests.

Ordinal regression was used to analyse the pain rating data. However ordinal regression only allows for comparisons to be made between a reference group and each of the other groups in the factor, and does not perform pairwise comparisons. Therefore analyses were also carried out using REML in order to make a comparison between these two different types of analysis. Although the pain rating data measured using a Likert style scale is technically on an ordinal scale and REML assumes that the data is on a continuous scale, treating Likert style data as continuous can be done provided other assumptions of the test are met (Lubke and Muthen, 2004). As anticipated both the REML and ordinal regression show very similar results, demonstrating the suitability of the REML analysis. To reduce the likelihood of type one errors (detecting an effect that is not present), assessment of false discovery rate (FDR) was used on the pain rating data where a large number of analyses were carried out. For the Residual Maximum Likelihood (REML) analyses a FDR was run generating a significance level of $p=0.007$ for both cattle and sheep. For the ordinal regression analyses the FDR calculation generated a significance level of $p=0.006$ for sheep and $p=0.016$ for cattle. A significance level of 0.05 was used to calculate the FDR.

3.2.1 Freedoms

Data on responses to questions relating to the Five Freedoms were not found to be normally distributed and were subsequently transformed using an arcsine transformation which achieved normality as assessed by inspection of the residual data. Analysis using REML involved stacking freedom data and fitting them as the response variate. Freedom type, experience (in years), farmer type and gender were all fitted as fixed effects. Experience was a covariate; all other fixed effects were treated as factors, i.e. as fixed effects in the analysis model. Participant number was fitted as the random effect in the statistical model.

3.2.2 Pain Capacity

Pain capacity data were found not found to be normally distributed and were subsequently transformed using an arcsine transformation which achieved normality as assessed by inspection of the residuals. Analysis was conducted using REML. Capacity to feel pain data were stacked and fitted as the response variate. Species, experience, farmer type and gender were all fitted as fixed effects. Experience was a covariate; all other fixed effects were factors. Participant number was fitted as the random model.

3.2.3 Attitudes

Exploratory PCA identified four statements that were positively orientated and six statements that were negatively orientated. Attitude statements were re-coded to reflect the direction of attitude. Positively orientated statements were coded so that the highest score of '5' was assigned to 'strongly agree' and the lowest score of '1' to 'strongly disagree'. For negatively orientated statements the opposite applied with 'strongly agree' answers being assigned a score of '1' and 'strongly disagree' statements a score of '5'. This resulted in high factor scores representing more positive, and low factor scores representing less positive attitudes to pain and analgesic use.

Exploratory PCA allows for a large number of variables, in this case the ten attitudes statements, to be reduced into a smaller number of components (component reduction). To ensure the data met the assumption of PCA two tests were run: the Kaiser-Meyer-Olkin measure of sampling adequacy indicated that the items in the attitudes scale had adequate commonalities to warrant component analysis, as did the Bartlett's test of sphericity which showed that there were adequate correlations between items. Initially eigenvalues above 1.0 were extracted, resulting in two components. Parallel analysis was then conducted to ascertain the statistically significant eigenvalues. Parallel analysis is considered superior to other techniques for identifying the number of components to retain, notably the Scree test or the Kaiser's eigenvalue-greater-than-one rule (Ledesma and Valero-Mora, 2007). Parallel analysis identified two components from the attitude scale. However the second component only contained two items, both of which loaded similarly on both components, in addition parallel analysis showed that the second component was only at border line significance, for these reasons it was decided that only one component should be extracted. PCA was re-run this time extracting one component (Table 2.8) and regression factor scores were generated. Analysis was conducted using REML. Attitude factor scores were fitted as the response variate. Experience, farmer type and gender were fitted as the fixed model. Experience was a covariate; all other fixed effects were factors. In addition in order to assess whether the ten attitudes statements were measuring the same psychological construct Cronbach's alpha test for internal reliability was performed. The analysis identified one item that when removed, increased the internal reliability of the scale. This item, '*some degree of pain is beneficial to the animal'* was thus removed achieving better internal reliability.

3.2.4 Pain rating

The analyses were carried out for sheep and cattle farmers separately. The attitude factor scores were split into three groups, 'high', 'medium' and 'low'. Attitude group, experience, and gender were fitted as explanatory variables. When analysing the pain ratings on all conditions and procedures combined, 'condition/procedure' was fitted as the random effect in addition to participant number.

4. Results

4.1 Response rate

'Face to face' recruitment of participants does not allow for response rate calculation. The postal distribution achieved a response rate of 28.4% for the sheep questionnaire and 30.8% for the cattle questionnaire. These responses were in line with response rates of similar studies looking at farmers' attitudes to pain in livestock: Cattle: 15% (Huxley and Whay 2007); 28% (Thomsen et al. 2012); 38% (Laven et al. 2009); Goats: 54% (Muri et al 2012); Pigs: 2% (Ison and Rutherford). In total 852 questionnaires were completed, 423 on sheep and 429 on cattle, 14 and 10% of these participants were female respectively (Table 2.3).

Table 2.3 Mean (range) age of farmers and frequency of farmer type and gender

Gender	**Mean (range) age in years**	**Percentage (number)**		
		Female	***Male***	***Unknown***
Sheep farmers	55 (13-84)	14.4 *(n=61)*	84.6 *(n=358)*	1.0 *(n=2)*
Cattle farmers	55 (12-95)	10.3 *(n=44)*	89.3 *(n=383)*	0.5 *(n=4)*
Total	_	12.3 *(n=105)*	87.0 *(n=741)*	0.7 *(n=6)*

4.2 Freedoms

To answer the first research question, '*do farmers view the acceptability of different potential welfare compromises differently*?' analyses were conducted. Overall high scores were given for all six of the Freedoms. However there were highly significant differences (p<0.001) between the VAS scores for the statements (Figure 2.1), with participants most strongly disagreeing with: '*it is acceptable if farm animals are not always treated promptly*' (prompt treatment). The statement that received the second highest level of disagreement was: '*it is acceptable if farm animals in pain are not always given pain relief*' (pain relief). Similar levels of agreement were assigned to the Freedoms referring to 'fear and distress', expression of 'normal behaviour' and the availability of shelter and a comfortable resting area (shelter). The freedom which received the lowest level of disagreement was: '*it is acceptable if farm animals are sometimes hungry*' (hunger), and this freedom did not differ significantly from shelter. An interaction (p=0.008) was found between Freedoms and experience; scores declined with experience for all but the provision of pain relief, which remained consistent with differing levels of experience (Table 2.4).

Table 2.4 Effect of farmer type, gender and experience on how farmers rated 'Freedoms'

	wald	f	df	*p*
Freedoms				
Farmer	1.91	1.91	833.0	0.167
Gender	0.29	0.29	833.0	0.593
Freedoms.Experience	15.63	3.13	4175.0	0.008

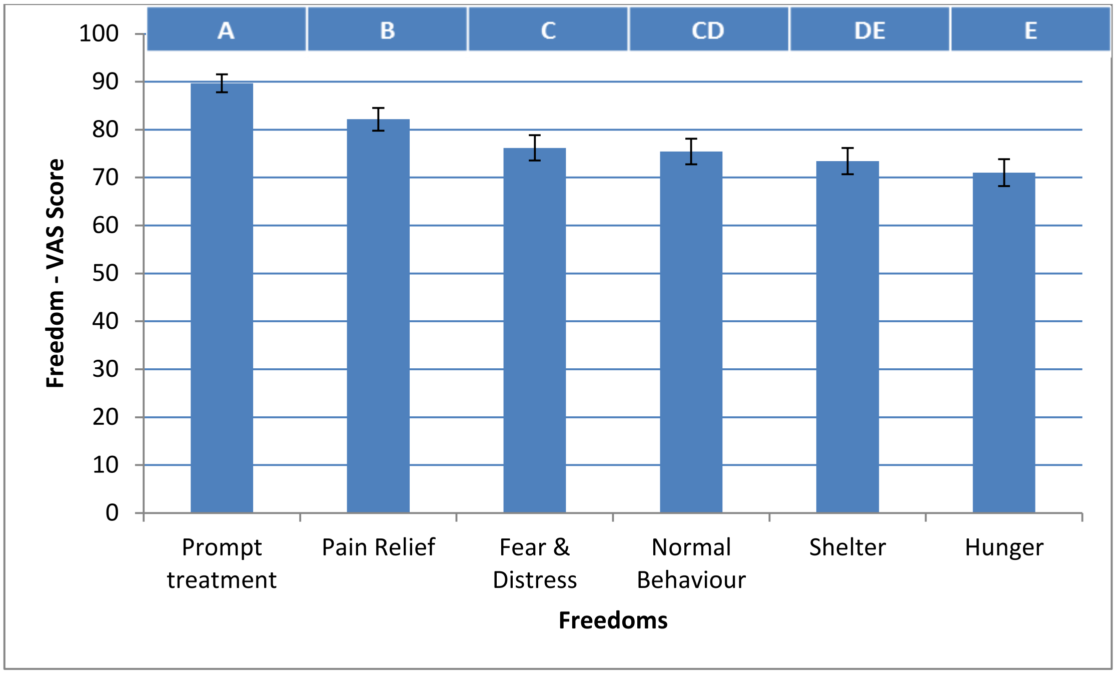

Figure 2.1 Mean (s.e.) scores of farmer's ratings of the acceptability of six welfare compromises. Items that do not share a letter are statistically different from each other at p<0.01.

4.3 Capacity to feel pain

To answer the second research question, '*do farmers perceive there to be a difference in the capacity of different species to feel pain*?' analyses were conducted. There was a highly significant species effect with humans being assigned the highest scores and turkeys the lowest (Figure 2.2). There was no significant difference between the pain capacity ratings for sheep and cattle. There was a highly significant effect of years of experience, on how farmers scored pain capacity (p<0.001), with lower scores being given by those with more experience (Table 2.5).

Table 2.5 Effect of experience, farmer type, gender and species on how farmers rated 'Capacity to Feel Pain'

	wald	f	df	*p*
Capacity to feel pain				
Experience	36.07	36.07	833.0	<0.001
Farmer	3.15	3.15	833.0	0.076
Gender	0.01	0.01	833.0	0.904
Species	591.87	197.29	2508.0	<0.001

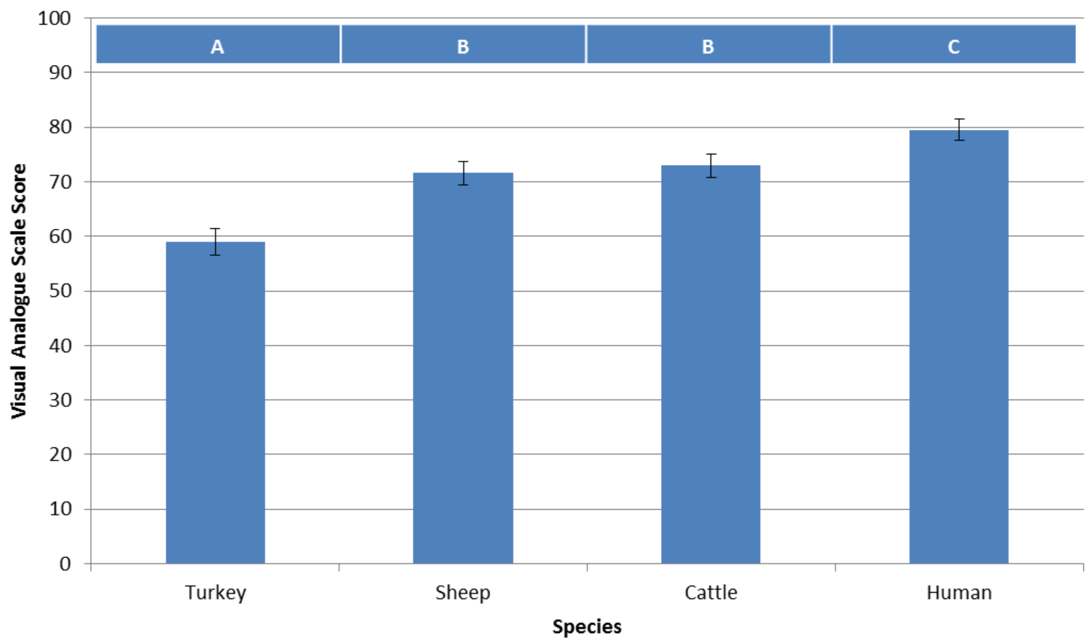

Figure 2.2 Mean (s.e.) scores of farmer's ratings of the capacity of different animal species to feel pain. Items that do not share a letter are statistically different from each other at p<0.01.

4.4 Attitudes to pain and analgesic use (APL)

To address the third research question, '*what are farmers' attitudes to pain and analgesic use?*' analyses were conducted. Overall very positive APL were reported (Table 2.9) with 93% of farmers agreeing that farm animals benefit from pain alleviation and 82% agreeing that animals recover better when given analgesia. Only 14% of sheep and 10% of cattle farmers agreed that analgesia was too expensive to use regularly whilst 74% of sheep and 82% of cattle farmers agreed they were happy to pay the cost of analgesia. The Kaiser-Meyer-Olkin measure of sampling adequacy indicated that the attitude statements had adequate commonalities to warrant component analysis, 0.819. Bartlett's test of sphericity showed that there were adequate correlations between the variables to allow for component reduction, Chi-Sq: 1476; df: 45, $p<0.001$. The Cronbach's alpha internal reliability was 0.77 which is considered good for a novel psychological scale. Factor loadings of each item on the APL scale are listed in Table 2.8.

A difference between cattle and sheep farmer attitudes was found, with cattle farmers having higher APL factor scores ($p<0.001$) (Table 2.7). Post hoc analysis grouped participants into having either 'high', 'medium' or 'low' pain related attitudes based on their attitude factor scores. The relationship between attitudes toward pain and how the Freedom concerning 'pain relief' was scored was investigated. A significant interaction between attitude and gender was found ($p=0.007$) (Table 2.7). Females from the low and medium scoring attitude groups scored the pain relief freedom higher than did males, but females from the high scoring attitude group scored the pain relief freedom lower than did males (Table 2.4). Females did not statistically differ (p>0.05) in how they scored the pain relief freedom based on their attitude group but males did. All three male groups were significantly different from each other (p<0.01), with those in the high attitude group giving the highest pain relief scores.

Table 2.6 Percentage (number) of males and females in each attitude group and mean (s.e.), 'pain relief' scores.

Attitude group	Female	Male
High	55.8% (n=24)	54.4% (n=204)
	85.7^{ab} (5.92)	90.0^{a} (1.89)
Medium	25.6% (n=11)	24.3% (n=91)
	84.6^{ab} (8.03)	79.9^{b} (3.48)
Low	18.6% (n=8)	21.3% (n=80)
	80.3^{ab} (9.75)	64.0^{c} (4.22)

Groups that do not share a letter are statistically different from each other at p<0.01

Table 2.7 Effect of experience, farmer type, and gender on farmer's 'Attitude Factor' scores and the relationship between 'Attitude group' and the 'Pain Relief' Freedom

	wald	f	df	*p*
Attitudes				
Experience	0.09	0.09	814.0	0.768
Farmer	12.45	12.45	814.0	<0.001
Gender	0.44	0.44	814.0	0.505
Provision of Pain Relief (Freedoms)				
Experience	0.86	0.86	810.0	0.354
Farmer	0.02	0.02	810.0	0.902
AttitudeGroup.Gender	9.99	5.00	810.0	0.007

Table 2.8 Factor loadings and means scores (standard deviation) of each item on the 'attitudes to pain and analgesic use' scale, and eigenvalue of the attitude component and Cronbach's alpha (α) internal reliability of the scale

	Loading	Mean (±SD)		Eigenvalue	α
Attitudes to pain and analgesic use				3.29	0.77
Providing pain relief is impractical most of the time as a result of the need for increased time and labour	0.77	3.80	(0.96)		
Difficulties with gathering and/or handling means that it is very difficult to administer pain relief	0.68	3.49	(1.08)		
Pain relieving drugs are not necessary for farm animals	0.62	4.31	(0.82)		
Pain relief drugs are too expensive to use regularly	0.63	3.37	(1.07)		
Farm animals benefit from pain alleviation	-0.57	4.46	(0.63)		
Farm animals recover better from an injury, disease or painful procedures when given pain relief drugs	-0.55	4.13	(0.89)		
It is difficult to recognise pain in farm animals	0.54	3.84	(0.98)		
The current management of animals at my farm offers sufficient opportunity to identify animals in pain	-0.50	4.31	(0.62)		
In general I am happy to pay the cost involved with giving pain relieving drugs	-0.49	3.90	(0.85)		

Table 2.9 Percentage (number) of farmers for each level of agreement with 10 statements about pain and analgesic use

	Farmer	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
		Percentage *(number)*				
Farm animals benefit from pain alleviation	**Sheep *(n=412)***	50.7% *(n=209)*	43.7% *(n=180)*	5.1% *(n=21)*	0.0% *(n=0)*	0.5% *(n=2)*
	Cattle *(n=424)*	53.3% *(n=226)*	42.7% *(n=181)*	3.3% *(n=14)*	0.5% *(n=2)*	0.2% *(n=1)*
The current management of animals at my farm offers sufficient opportunity to identify animals in pain	**Sheep *(n=410)***	32.9% *(n=135)*	61.2% *(n=251)*	5.4% *(n=22)*	0.5% *(n=2)*	0.0% *(n=0)*
	Cattle *(n=421)*	43.5% *(n=183)*	51.1% *(n=215)*	4.0% *(n=17)*	1.0% *(n=4)*	0.5% *(n=2)*
Pain relief drugs are too expensive to use regularly	**Sheep *(n=411)***	1.6% *(n=22)*	12.8% *(n=86)*	25.7% *(n=115)*	41.5% *(n=139)*	18.3% *(n=49)*
	Cattle *(n=420)*	1.1% *(n=16)*	9.6% *(n=70)*	21.5% *(n=104)*	45.7% *(n=166)*	22.0% *(n=64)*
Providing pain relief is impractical most of the time as a result of the need for increased time and labour	**Sheep *(n=409)***	2.7% *(n=11)*	12.5% *(n=51)*	18.6% *(n=76)*	46.9% *(n=192)*	19.3% *(n=79)*
	Cattle *(n=421)*	1.7% *(n=7)*	6.7% *(n=28)*	14.3% *(n=60)*	51.5% *(n=217)*	25.9% *(n=109)*
Difficulties with gathering and/or handling means that is it difficult to administer pain relief	**Sheep *(n=415)***	3.4% *(n=14)*	24.6% *(n=102)*	17.1% *(n=71)*	41.7% *(n=173)*	13.3% *(n=55)*
	Cattle *(n=423)*	1.9% *(n=8)*	18.4% *(n=78)*	15.8% *(n=67)*	44.2% *(n=187)*	19.6% *(n=83)*

Table 2.10 (*continued*) Percentage (number) of farmers for each level of agreement with 10 statements about pain and analgesic use

		Percentage *(number)*				
	Farmer	***Strongly Agree***	***Agree***	***Neither Agree nor Disagree***	***Disagree***	***Strongly Disagree***
Pain relieving drugs are not necessary for farm animals	**Sheep *(n=407)***	1.7% *(n=7)*	2.2% *(n=9)*	7.6% *(n=31)*	44.2% *(n=180)*	44.2% *(n=180)*
	Cattle *(n=421)*	1.7% *(n=7)*	1.7% *(n=7)*	5.9% *(n=25)*	39.9% *(n=168)*	50.8% *(n=214)*
In general I am happy to pay the cost involved with giving pain relieving drugs	**Sheep *(n=412)***	17.5% *(n=72)*	58.0% *(n=239)*	16.5% *(n=68)*	6.6% *(n=27)*	1.5% *(n=6)*
	Cattle *(n=426)*	22.8% *(n=97)*	59.4% *(n=253)*	10.3% *(n=44)*	5.2% *(n=22)*	2.3% *(n=10)*
Farm animals recover better from an injury, disease or painful procedures when given pain relief drugs	**Sheep *(n=409)***	32.5% *(n=133)*	49.1% *(n=201)*	12.7% *(n=52)*	2.7% *(n=11)*	2.9% *(n=12)*
	Cattle *(n=422)*	40.0% *(n=169)*	45.7% *(n=193)*	9.5% *(n=40)*	2.6% *(n=11)*	2.1% *(n=9)*
It is difficult to recognise pain in farm animals	**Sheep *(n=414)***	1.7% *(n=7)*	12.6% *(n=52)*	9.2% *(n=38)*	54.3% *(n=225)*	22.2% *(n=92)*
	Cattle *(n=425)*	1.2% *(n=5)*	12.7% *(n=54)*	10.6% *(n=45)*	50.6% *(n=215)*	24.9% *(n=106)*
Some degree of pain is beneficial to the animal	**Sheep *(n=413)***	2.9% *(n=12)*	5.6% *(n=23)*	10.2% *(n=42)*	37.8% *(n=156)*	43.6% *(n=180)*
	Cattle *(n=425)*	2.4% *(n=10)*	5.9% *(n=25)*	10.6% *(n=45)*	34.8% *(n=148)*	46.4% *(n=197)*

4.5 Pain ratings

The majority, 91%, of farmers rated their ability to recognise pain in their animals as either good, very good, or excellent, yet only 79% rated their ability to control pain as good, very good, or excellent (Table 2.11).

To answer the fourth research question, '*is there a relationship between farmers' attitudes to pain and analgesic use and how farmers rate the pain associated with different conditions and procedures*?' analyses of pain rating data was carried out. This was done using both ordinal regression and REML as a way of comparing analyses that treat the data differently, as ordinal and continuous respectively. The results from both sets of analyses are similar; final significant effects and interactions are shown in Table 2.12.

Table 2.11 Percentage (number) of farmers in how they self-rated their own ability to assess and control pain in sheep/cattle

	Excellent	*Very good*	*Good*	*Fair*	*Poor*	*Very poor*	*No ability*	*Don't Know*
Sheep farmers								
How would you rate your ability to assess pain in sheep (n=418)	12.9 *(n=54)*	41.4 *(n=173)*	35.2 *(n=147)*	9.6 *(n=40)*	0.2 *(n=1)*	0.5 *(n=2)*	0.2 *(n=1)*	0.0 *(n=0)*
How would you rate your knowledge of how to control pain in sheep (n=418)	6.2 *(n=26)*	30.6 *(n=128)*	38.5 *(n=161)*	20.8 *(n=87)*	3.1 *(n=13)*	0.5 *(n=2)*	0.2 *(n=1)*	0.0 *(n=0)*
Cattle farmers								
How would you rate your ability to assess pain in cattle (n=427)	16.4 *(n=70)*	42.9 *(n=183)*	33.5 *(n=143)*	6.8 *(n=29)*	0.2 *(n=1)*	0 *(n=0)*	0 *(n=0)*	0.2 *(n=1)*
How would you rate your knowledge of how to control pain in cattle (n=427)	7.7 *(n=33)*	36.1 *(n=154)*	39.3 *(n=168)*	14.8 *(n=63)*	1.9 *(n=8)*	0.0 *(n=0)*	0.0 *(n=0)*	0.2 *(n=1)*

4.5.1 Pain ratings in Sheep

Sheep farmers rated difficult lambing as the most painful condition with a mean score of 4.1 out of 5, which is roughly equivalent to a pain rating of severe pain. Ear marking was considered the least painful with a pain rating of 2.3, which is equivalent to a pain rating of mild to moderate pain (Figure 2.3). For the combined pain scores there was an interaction between attitude group and experience ($p<0.001$) with pain ratings decreasing with experience for those in the high and medium attitude groups and increasing with experience for those in the low attitude group.

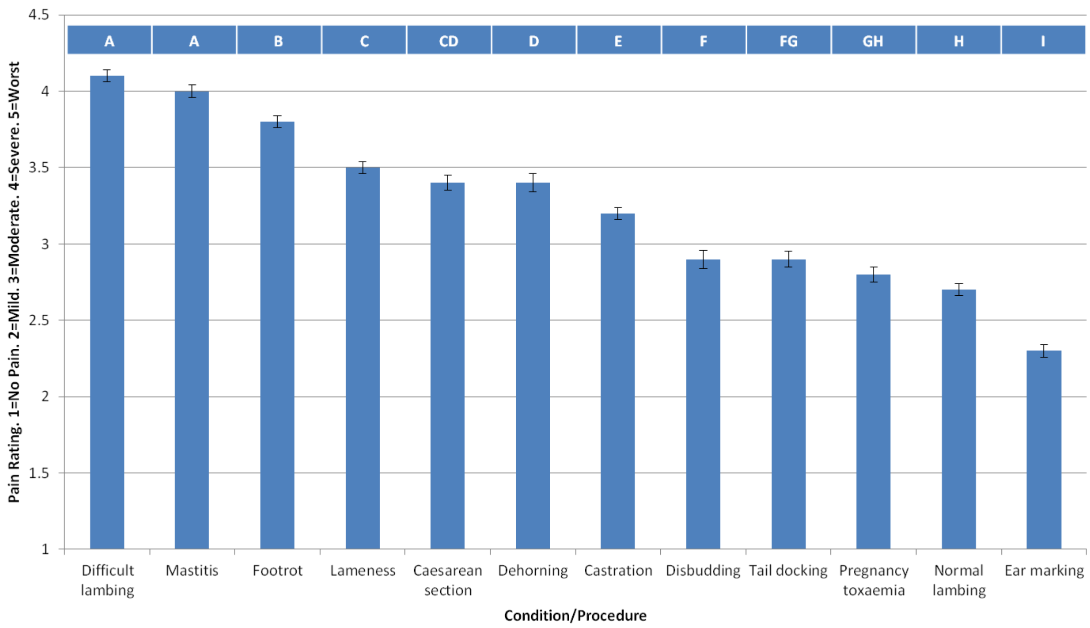

Figure 2.3 Mean (s.e.) scores of farmer's pain ratings of 12 conditions and procedures that affect sheep. Items that do not share a letter are significantly different from each other at p<0.01.

Ordinal regression results

No effect of attitude, experience or gender was found on the pain rating of: lameness, ear marking, normal lambing, difficult lambing, footrot, mastitis, caesarean section, disbudding or dehorning (Table 2.15). Those with high attitude scores rated the pain associated with pregnancy toxaemia significantly higher than did those with low attitude scores (p=0.001). Those with high attitude scores rated the pain associated with castration ($p<0.001$; $p=0.002$) and tail docking ($p<0.001$, $p=0.006$) significantly higher than those with medium or low attitude scores respectively.

REML results

No effect of attitude, experience or gender was found on the pain rating of: lameness, ear marking, normal lambing, difficult lambing, footrot, mastitis, disbudding or dehorning (Table 2.13). A significant effect of attitude on the pain rating of pregnancy toxaemia was found. Farmers with low attitude scores rated the pain significantly lower than those with medium ($p<0.05$) and high attitude scores ($p<0.001$). A significant interaction between attitude and experience for the pain rating of castration was found ($p=0.004$). Those with medium or low attitude scores did not differ in how they rated the pain associated with castration regardless of their level of experience, however experienced farmers with high attitude scores rated pain lower than inexperienced farmers with high attitude scores. A significant interaction between attitude and experience was found for the pain rating of tail docking (p=0.003). Farmers with high attitude scores rated tail docking pain higher when they were inexperienced compared to those with experience. A significant interaction between attitude and gender was found (p<0.001) for the pain rating of caesarean section. Females with medium or low attitude scores rated caesarean section pain higher than did males. However the opposite is true for those with high attitude scores, with males assigning higher pain ratings than females.

4.5.2 Pain Ratings in Cattle

Farmers rated difficult calving as the most painful with a mean score of 4 out of 5, which is equivalent to a severe pain rating. Ear marking and freeze branding were rated the least painful with pain mean scores of 2.4 and 2.3 respectively, which is equivalent to a mild to moderate pain rating (Figure 2.4). For the combined pain scores there was a significant effect of attitude (p=0.006), as those with high attitude scores rated pain significantly higher (mean: 3.1; se: 0.19) than those with low scores (mean: 2.8; se: 0.19). No effect of attitude, experience or gender was found on the pain ratings of: lameness, hot iron branding, or disbudding.

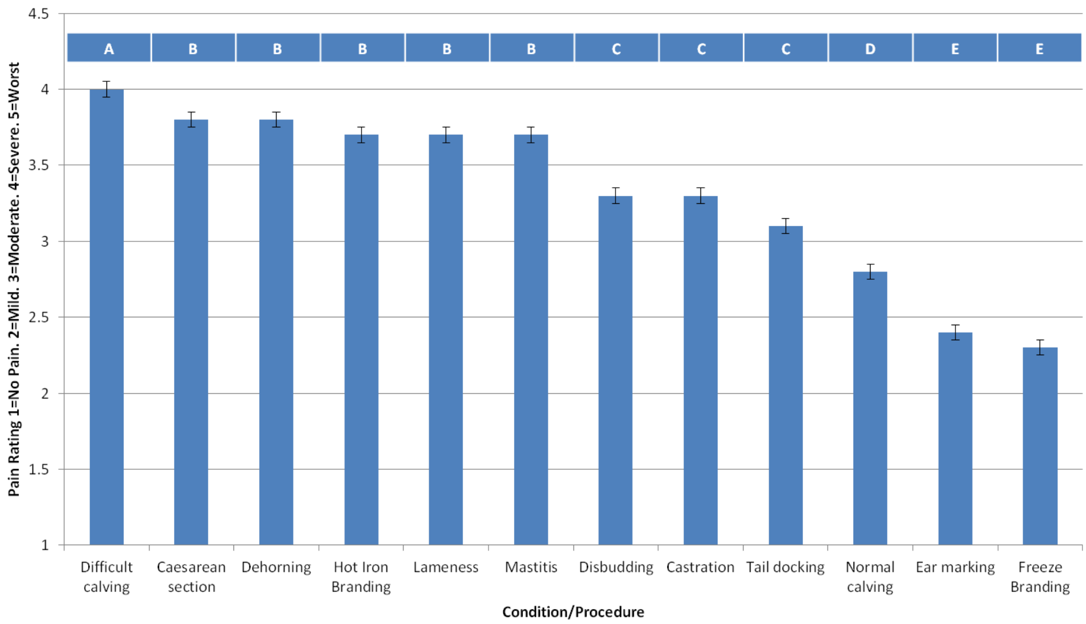

Figure 2.4 Mean (s.e.) scores of farmer's pain ratings of 12 conditions and procedures that affect cattle. Items that do not share a letter are significantly different from each other at p<0.01.

Ordinal regression results

Those with high attitude scores rated the pain associated with mastitis (p=0.032; p=0.002) caesarean section (p=0.012; p=0.005) and castration (p=0.012; p=<0.001) higher than did those with medium or low attitude scores respectively (Table 2.16). Those with high attitude scores rated the pain associated with dehorning (p=0.009) and tail docking (p=0.004) higher than those with low attitude scores. Females rated the pain associated with mastitis (p=0.016), normal calving (p<0.001), difficult calving (p=0.005), freeze branding (p=0.012) and ear marking (p=0.015) higher than did males. Those with more experience rated the pain associated with caesarean section (p=0.002) and castration (p=0.008) lower than those with less experience.

REML results

Farmers with high attitude scores rated the pain associated with castration significantly higher than those with medium ($p=0.01$) or low scores ($p=0.004$) (Table 2.14). Farmers with high attitude scores rated the pain associated with mastitis ($p=0.001$) and caesarean ($p=0.001$) significantly higher than those with medium scores. Farmers with more experience rated the pain associated with caesarean section lower than those with less experience ($p=0.002$). Females rated the pain associated with normal calving ($p<0.001$) and difficult calving ($p=0.007$) higher than did males.

Table 2.12 Comparison of the significant effects of Attitude Group, Experience, and Gender on farmers' pain ratings using two analysis techniques: REML and Ordinal regression.

	False Discovery Rate	
Sheep conditions/procedures	**p<0.007 REML**	**p<0.006 Ordinal Regression**
Castration	AttitudeGroup.Experience	AttitudeGroup
Caesarean section	AttitudeGroup.Gender	
Pregnancy toxaemia	AttitudeGroup	AttitudeGroup
Tail docking	AttitudeGroup.Experience	AttitudeGroup

	False Discovery Rate	
Cattle conditions/procedures	**p<0.007 REML**	**p<0.016 Ordinal Regression**
Castration	AttitudeGroup	AttitudeGroup + Experience
Caesarean section	AttitudeGroup + Experience	AttitudeGroup + Experience
Difficult Calving	Gender	Gender
Normal Calving	Gender	Gender
Mastitis	AttitudeGroup	AttitudeGroup + Gender
Dehorning		AttitudeGroup
Tail docking		AttitudeGroup
Freeze branding		Gender

Table 2.13 Effects of Attitude Group, Experience, and Gender on sheep farmers' pain ratings for twelve conditions and procedures.

		wald	f	df	*p*
All Conditions/Procedures	AttitudeGroup.Experience	16.69	8.35	396.5	<0.001
	Gender	1.66	1.66	398.4	0.199
Castration	AttitudeGroup.Experience	11.14	5.57	389.0	0.004
	Gender	2.69	2.69	389.0	0.102
Caesarean section	AttitudeGroup.Gender	23.33	11.67	346.0	<0.001
	Experience	2.06	2.06	346.0	0.152
Dehorning	AttitudeGroup	4.90	2.45	230.0	0.089
	Experience	0.00	0.00	230.0	0.944
	Gender	0.57	0.57	230.0	0.452
Difficult lambing	AttitudeGroup	3.83	1.92	394.0	0.149
	Experience	4.55	4.55	394.0	0.034
	Gender	3.41	3.41	394.0	0.065
Disbudding	AttitudeGroup	3.64	1.82	217.0	0.164
	Experience	0.03	0.03	217.0	0.861
	Gender	0.08	0.08	217.0	0.783
Ear marking	AttitudeGroup	2.58	1.29	393.0	0.277
	Experience	1.70	1.70	393.0	0.193
	Gender	1.49	1.49	393.0	0.223
Footrot	AttitudeGroup	4.77	2.38	385.0	0.094
	Experience	0.10	0.10	385.0	0.747
	Gender	1.34	1.34	385.0	0.248
Lameness	AttitudeGroup	1.48	0.74	386.0	0.477
	Experience	1.91	1.91	386.0	0.167
	Gender	0.44	0.44	386.0	0.505
Mastitis	AttitudeGroup	5.76	2.88	391.0	0.057
	Experience	2.09	2.09	391.0	0.149
	Gender	3.67	3.67	391.0	0.056
Normal lambing	AttitudeGroup	0.82	0.41	390.0	0.665
	Experience	3.03	3.03	390.0	0.082
	Gender	0.59	0.59	390.0	0.443
Pregnancy toxaemia	AttitudeGroup	14.55	7.28	344.0	<0.001
	Experience	2.17	2.17	344.0	0.142
	Gender	0.15	0.15	344.0	0.702
Tail docking	AttitudeGroup.Experience	11.70	5.85	376.0	0.003
	Gender	0.13	0.13	376.0	0.715

Table 2.14 Effects of 'Attitude Group', Experience', and 'Gender' on cattle farmers' pain ratings for twelve conditions and procedures.

		wald	f	df	*p*
All Conditions/Procedures	AttitudeGroup	58.10	29.05	4395.4	<0.001
	Experience	3.06	3.06	4389.5	0.080
	Gender	10.34	10.34	4391.4	0.001
Castration	AttitudeGroup	11.56	5.76	386.0	0.003
	Experience	3.96	3.96	386.0	0.047
	Gender	0.29	0.29	386.0	0.588
Caesarean section	AttitudeGroup	11.16	5.58	360.0	0.004
	Experience	9.98	9.98	360.0	0.002
	Gender	0.12	0.12	360.0	0.727
Dehorning	AttitudeGroup	6.27	3.13	372.0	0.045
	Experience	3.42	3.42	372.0	0.065
	Gender	4.50	4.50	372.0	0.035
Difficult calving	AttitudeGroup	7.02	3.51	397.0	0.026
	Experience	0.03	0.03	397.0	0.857
	Gender	7.29	7.29	397.0	0.007
Disbudding	AttitudeGroup	3.63	1.82	395.0	0.164
	Experience	0.47	0.47	395.0	0.494
	Gender	0.00	0.00	395.0	0.965
Ear marking	AttitudeGroup	3.66	1.83	393.0	0.162
	Experience	0.64	0.64	393.0	0.422
	Gender	5.84	5.84	393.0	0.016
Freeze branding	AttitudeGroup	0.85	0.42	318.0	0.656
	Experience	1.06	1.06	318.0	0.304
	Gender	4.52	4.52	318.0	0.034
Hot Iron branding	AttitudeGroup	4.62	2.31	284.0	0.101
	Experience	2.96	2.96	284.0	0.086
	Gender	1.64	1.64	284.0	0.201
Lameness	AttitudeGroup	1.59	0.79	401.0	0.453
	Experience	2.97	2.97	401.0	0.086
	Gender	1.10	1.10	401.0	0.296
Mastitis	AttitudeGroup	11.61	5.81	367.0	0.003
	Experience	0.18	0.18	367.0	0.674
	Gender	5.35	5.35	367.0	0.021
Normal calving	AttitudeGroup	1.17	0.86	392.0	0.426
	Experience	0.16	0.16	392.0	0.686
	Gender	11.02	11.02	392.0	<0.001
Tail docking	AttitudeGroup	7.95	3.97	287.0	0.020
	Experience	0.21	0.21	287.0	0.648
	Gender	0.45	0.45	287.0	0.504

Table 2.15 Mean (s.e.) and median (first and third quartile) scores of sheep farmer’s pain ratings for twelve conditions and procedures that affect sheep

Sheep	**Attitudes**						**Gender**				**Experience**	
Condition/procedure scored	**Negative** (Neg)	**Neutral** (Neu)	**Positive** (P)	**Group compare**	**Odds ratio**	***p***	**Female**	**Male**	**Odds Ratio**	***p***	**Odds ratio**	***p***
Footrot	3.7 (0.07)	3.9 (0.07)	3.9 (0.05)	*High-Med*	1.09	0.684	3.9 (0.09)	3.8 (0.04)	1.37	0.247	1.00	0.764
	4 (3,4)	4 (3,4)	4 (3,4)	*High-Low*	1.47	0.036	4 (4,4)	4 (3,4)				
	n=111 (28.2%)	*n*=109 (27.7%)	*n*=173 (44.0%)				*n*=59 (14.8%)	*n*=341 (85.3%)				
Lameness	3.6 (0.08)	3.5 (0.07)	3.5 (0.06)	*High-Med*	0.95	0.823	3.5 (0.10)	3.5 (0.04)	1.19	0.523	0.99	0.251
	4 (3,4)	4 (3,4)	4 (3,4)	*High-Low*	0.69	0.112	4 (3,4)	4 (3,4)				
	n=113 (28.5%)	*n*=109 (27.5%)	*n*=174 (43.9%)				*n*=59 (14.6%)	*n*=344 (85.4%)				
Mastitis	3.9 (0.07)	4.1 (0.07)	4.1 (0.05)	*High-Med*	1.02	0.919	4.2 (0.08)	4.0 (0.04)	1.66	0.070	0.99	0.172
	4 (3,4)	4, (4,4)	4 (4,4)	*High-Low*	1.71	0.024	4 (4,5)	4 (4,5)				
	n=115 (28.7%)	*n*=111 (27.7%)	*n*=175 (43.6)				*n*=60 (14.7%)	*n*=348 (85.3%)				
Pregnancy toxaemia	2.5 (0.10)	2.8 (0.10)	3.0 (0.08)	*High-Med*	1.50	0.061	2.9 (0.14)	2.8 (0.06)	1.02	0.940	1.01	0.269
	2 (2,3)	3 (2,3)	3 (2,4)	*High-Low*	2.11	0.001	3 (2,3)	3 (2,3)				
	n=101 (28.5%)	*n*=95 (26.8%)	*n*=158 (44.6%)				*n*=51 (14.2%)	*n*=308 (85.8)				
Normal lambing	2.6 (0.06)	2.7 (0.07)	2.7 (0.05)	*High-Med*	1.00	0.993	2.8 (0.09)	2.7 (0.04)	1.17	0.582	1.01	0.055
	3 (2,3)	3 (2,3)	3 (2,3)	*High-Low*	1.19	0.455	3 (2,3)	3 (2.3)				
	n=115 (28.8%)	*n*=112 (28.0%)	*n*=173 (43.3%)				*n*=60 (14.8%)	*n*=345 (85.2%)				
Difficult lambing	4.0 (0.06)	4.0 (0.06)	4.1 (0.05)	*High-Med*	1.51	0.087	4.2 (0.08)	4.0 (0.04)	1.63	0.083	1.02	0.040
	4 (4,4)	4 (4,4)	4 (4,5)	*High-Low*	1.43	0.134	4 (4,5)	4 (4,4)				
	n=117 (29.0%)	*n*=112 (27.7%)	*n*=175 (43.3%)				*n*=60 (14.6)	*n*=350 (85.4%)				
Caesarean section	3.3 (0.13)	3.2 (0.12)	3.5 (0.11)	*High-Med*	1.60	0.041	3.4 (0.17)	3.4 (0.08)	0.97	0.898	1.01	0.045
	3 (2,5)	3 (2,4)	4 (2.5, 5)	*High-Low*	1.46	0.101	3 (3,5)	3 (2,5)				
	n=98 (27.5%)	*n*=98 (27.5%)	*n*=161 (45.1%)				*n*=55 (15.2%)	*n*=308 (84.8%)				
Castration	3.0 (0.09)	3.0 (0.08)	3.4 (0.08)	*High-Med*	2.07	0.001	3.3 (0.12)	3.1 (0.05)	1.44	0.162	1.01	0.064
	3 (2,4)	3 (2,4)	3 (3,4)	*High-Low*	1.97	0.002	3 (3,4)	3 (2,4)				
	n=115 (28.7%)	*n*=110 (27.4%)	*n*=176 (43.9%)				*n*=60 (14.7%)	*n*=348 (85.3%)				
Tail docking	2.8 (0.08)	2.7 (0.08)	3.1 (0.07)	*High-Med*	2.40	0.000	2.9 (0.12)	2.9 (0.05)	1.06	0.839	1.00	0.937
	3 (2,3)	3 (2,3)	3 (2,4)	*High-Low*	1.89	0.006	3 (2,4)	3 (2,3)				
	n=112 (28.9%)	*n*=110 (28.4%)	*n*=166 (42.8%)				*n*=59 (14.9%)	*n*=336 (85.1%)				
Disbudding	2.8 (0.11)	3.1 (0.12)	2.9 (0.08)	*High-Med*	1.35	0.175	2.9 (0.16)	2.9 (0.06)	1.05	0.865	1.02	0.013
	3 (2,3)	3 (2.5, 4)	3 (2, 3)	*High-Low*	1.27	0.275	3 (2.5,3)	3 (2,3)				
	n=63 (28.0%)	*n*=53 (23.6%)	*n*=109 (48.4%)				*n*=33 (14.4%)	*n*=196 (85.6%)				
Dehorning	3.2 (0.12)	3.3 (0.13)	3.5 (0.07)	*High-Med*	1.50	0.066	3.2 (0.15)	3.3 (0.06)	1.03	0.897	1.02	0.008
	3 (3,4)	3 (3,4)	3 (3,4)	*High-Low*	1.43	0.108	3 (3,4)	3 (3,4)				
	n=66 (27.7%)	*n*=59 (24.8%)	*n*=113 (47.5%)				*n*=37 (15.2%)	*n*=207 (84.8%)				
Ear marking	2.2 (0.06)	2.3 (0.06)	2.2 (0.05)	*High-Med*	0.63	0.064	2.3 (0.09)	2.2 (0.03)	1.70	0.066	0.99	0.334
	2 (2,3)	2 (2,3)	2 (2,3)	*High-Low*	0.97	0.904	2 (2,3)	2 (2,3)				
	n=115 (28.5%)	*n*=112 (27.8%)	*n*=176 (43.7%)				*n*=59 (14.4%)	*n*=351 (85.6%)				
All conditions/procedures	3.2 (0.03)	3.1 (0.03)	3.3 (0.02)	*High-Med*	3.30	0.001	3.3 (0.04)	3.2 (0.02)	0.85	0.044	1.00	0.112
	3 (2,4)	3 (2,4)	3 (3,4)	*High-Low*	4.64	0.000	3 (3,4)	3 (2,4)				
	n=1190 (27.3%)	*n*=1241 (28.5%)	*n*=1929 (44.2%)				*n*=652 (14.7%)	*n*=3782 (85.3%)				

Table 2.16 Mean (s.e.) and median (first and third quartile) scores of cattle farmer's pain ratings for twelve conditions and procedures that affect cattle

Cattle	**Attitudes**						**Gender**				**Experience**	
Condition/procedure scored	**Negative** (Neg)	**Neutral** (Neu)	**Positive** (P)	**Group compare**	**Effect z**	***p***	**Female**	**Male**	**Effect z**	***p***	**Effect z**	***p***
Lameness	3.6 (0.08)	3.8 (0.07)	3.7 (0.05)	*High-Med*	-0.25	0.801	3.8 (0.13)	3.7 (0.04)	-1.16	0.247	-1.52	0.129
	4 (3,4)	4 (3,4)	4 (3,4)	*High-Low*	1.15	0.250	4 (3,4)	4 (3,4)				
	n=85 (20.7%)	*n*=99 (24.1%)	*n*=227 (55.2%)				*n*=44 (10.6%)	*n*=373 (89.4%)				
Mastitis	3.5 (0.11)	3.7 (0.08)	3.9 (0.06)	*High-Med*	2.15	0.032	2.4 (0.11)	2.2 (0.03)	-2.41	0.016	0.45	0.651
	4 (3,4)	4 (3,4)	4 (3,4)	*High-Low*	3.12	0.002	2 (2,3)	2 (2,2)				
	n=76 (20.3%)	*n*=94 (25.1%)	*n*=205 (54.7%)				*n*=44 (10.8%)	*n*=365 (89.2%)				
Normal calving	2.7 (0.08)	2.7 (0.07)	2.8 (0.04)	*High-Med*	0.78	0.433	3.0 (0.11)	2.7 (0.03)	-3.34	0.001	-0.36	0.721
	3 (2,3)	3 (2,3)	3 (2,3)	*High-Low*	1.29	0.197	3 (3,3.75)	3 (2,3)				
	n=84 (20.9%)	*n*=97 (24.2%)	*n*=220 (54.9%)				*n*=44 (10.8%)	*n*=362 (89.2%)				
Difficult calving	3.8 (0.08)	3.9 (0.07)	4.0 (0.04)	*High-Med*	1.89	0.059	4.2 (0.10)	3.9 (0.03)	-2.81	0.005	-1.08	0.279
	4 (3,4)	4 (3.25,4)	4 (4,4)	*High-Low*	2.07	0.039	4 (4,5)	4 (4,4)				
	n=86 (21.2%)	*n*=100 (24.6%)	*n*=220 (54.2%)				*n*=43 (10.4%)	*n*=369 (89.6%)				
Caesarean section	3.3 (0.13)	3.4 (0.12)	3.8 (0.08)	*High-Med*	2.52	0.012	3.8 (0.16)	3.6 (0.07)	-0.10	0.917	3.11	0.002
	3 (3,4)	3 (3,4)	4 (3,5)	*High-Low*	2.84	0.005	4 (3,5)	4 (3,5)				
	n=74 (20.1%)	*n*=92 (24.9%)	*n*=203 (55.0%)				*n*=38 (10.2)	*n*=335 (89.8%)				
Freeze branding	2.3 (0.09)	2.4 (0.09)	2.4 (0.06)	*High-Med*	0.55	0.582	2.6 (0.16)	2.3 (0.05)	-2.52	0.012	-2.01	0.045
	2 (2,3)	2 (2,3)	2 (2,3)	*High-Low*	1.24	0.214	3 (2,3)	2 (2,3)				
	n=64 (19.7%)	*n*=78 (24.0%)	*n*=183 (56.3%)				*n*=33 (10.0%)	*n*=297 (90.0%)				
Hot iron branding	3.5 (0.10)	3.6 (0.11)	3.7 (0.07)	*High-Med*	1.07	0.285	3.8 (0.18)	3.7 (0.05)	-1.58	0.114	-1.71	0.087
	3 (3,4)	4 (3,4)	4 (3,4)	*High-Low*	1.95	0.051	4 (3,4.5)	4 (3.4)				
	n=59 (20.3%)	*n*=78 (24.0%)	*n*=183 (56.3%)				*n*=29 (9.9%)	*n*=264 (90.1%)				
Castration	3.0 (0.09)	3.0 (0.10)	3.4 (0.07)	*High-Med*	2.50	0.012	3.3 (0.14)	3.2 (0.05)	-0.21	0.830	2.65	0.008
	3 (2,4)	3 (2,4)	3 (3,4)	*High-Low*	3.46	0.001	3 (3,4)	3 (3,4)				
	n=80 (20.2%)	*n*=95 (24.0%)	*n*=221 (55.8%)				*n*=41 (10.3%)	*n*=359 (89.8%)				
Disbudding	2.9 (0.11)	3.0 (0.10)	3.1 (0.06)	*High-Med*	1.39	0.166	3.0 (0.16)	3.0 (0.05)	0.15	0.884	0.77	0.443
	3 (2,4)	3 (2,4)	3 (3,4)	*High-Low*	1.78	0.075	3 (2,4)	3 (2,4)				
	n=84 (20.8%)	*n*=98 (24.3 %)	*n*=222 (55.0%)				*n*=41 (10.0%)	*n*=369 (90.0%)				
Dehorning	3.4 (0.11)	3.5 (0.10)	3.7 (0.06)	*High-Med*	1.49	0.137	3.3 (0.18)	3.6 (0.05)	1.99	0.047	1.84	0.066
	3 (3,4)	4 (3,4)	4 (3,4)	*High-Low*	2.62	0.009	3 (3,4)	4 (3,4)				
	n=81 (21.2%)	*n*=93 (24.3%)	*n*=208 (54.5%)				*n*=36 (9.3%)	*n*=351 (90.7%)				
Ear marking	2.2 (0.06)	2.2 (0.06)	2.3 (0.04)	*High-Med*	1.53	0.126	2.4 (0.11)	2.2 (0.03)	-2.44	0.015	-0.54	0.587
	2 (2,2)	2 (2,2)	2 (2,3)	*High-Low*	1.51	0.132	2 (2,3)	2 (2,2)				
	n=85 (21.1%)	*n*=97 (24.1%)	*n*=221 (54.8%)				*n*=44 (10.8%)	*n*=89.2%)				
Tail docking	3.0 (0.12)	3.2 (0.11)	3.3 (0.07)	*High-Med*	0.76	0.446	3.3 (0.19)	3.2 (0.05)	-0.64	0.520	0.32	0.749
	3 (2,4)	3 (2.5,4)	3 (3,4)	*High-Low*	2.92	0.004	3 (3,4)	3 (2.5,4)				
	n=64 (21.7%)	*n*=69 (23.4%)	*n*=162 (54.9%)				*n*=29 (9.7%)	*n*=269 (90.3%)				
All conditions/procedures	2.8 (0.04)	3.0 (0.04)	3.1 (0.03)	*High-Med*	2.47	0.014	3.0 (0.06)	3.0 (0.02)	-1.38	0.168	1.67	0.094
	3 (2,4)	3 (2,4)	3 (2,4)	*High-Low*	5.47	0.000	3 (2,4)	3 (2,4)				
	n=1007 (20.8%)	*n*=1162 (24.0%)	*n*=2669 (55.2%)				*n*=520 (10.6%)	*n*=4380 (89.4%)				

5. Discussion

An acceptable sample size of 852 farmers was achieved, giving a response rate of 30% which can be considered in line with response rates of similar studies looking at farmers attitudes to pain in livestock: Cattle: 15% (Huxley and Whay 2007); 28% (Thomsen et al. 2012); 38% (Laven et al. 2009); Goats: 54% (Muri et al 2012); Pigs: 2% (Ison and Rutherford, 2014). The median age of participants was 55, which is just below the 2010 UK median age of 59 (DEFRA et al., 2012).

Nine out of the ten attitude statements that were designed and adapted to assess farmers' views on pain and analgesic use were retained after PCA, with a high internal reliability as assessed by Cronbach's alpha statistical test. A factor regression score was generated for each participant based on their responses to each of these nine statements. Subsequent analyses showed attitudinal differences between cattle and sheep farmers. A relationship was found between attitude scores and the pain ratings of a number of conditions and procedures including pregnancy toxaemia in sheep and castration, mastitis and caesarean in cattle. Overall farmers rated each of the Freedoms as being important, however they deemed 'prompt treatment' and the provision of 'pain relief' as the two most important aspects of welfare out of the six scenarios presented. Both cattle and sheep farmers assigned similar ratings to the capacity of cattle and sheep to feel pain. Gender differences were seen in the pain rating of normal and difficult calving, with females rating the pain higher than males. Attitudes to pain and analgesic use, gender and experience had effects on the pain ratings assigned to a number of conditions and procedures.

5.1 Freedoms - Do farmers view the acceptability of different potential welfare compromises differently?

How farmers view the importance of various animal welfare needs is likely to affect how they manage their animals. To my knowledge this is the first time a study has asked farmers about welfare scenarios based on the Five Freedoms welfare framework. On average farmers considered each of these welfare needs to be important, evidenced by average scores of over 70 out of 100 for all statements. However very clear differences were found, with ‘prompt treatment' of disease receiving the highest score, followed by the provision of ‘pain relief’ to animals in pain. The other four scenarios all received significantly lower ratings with hunger being considered the most acceptable. More psychological welfare concepts such as the absence of ‘fear & distress’ or the ability to perform ‘normal behaviours’ were viewed as intermediate and more basic requirements such as the lack of ‘shelter’ and the existence of ‘hunger’ were considered to be the most acceptable welfare compromises. The significant difference between ‘fear & distress’ and ‘hunger’ is perhaps surprising as both are a negative affective state, yet farmers deemed the experience of ‘hunger’ to be more acceptable than the experience of ‘fear & distress’. Previous research found that farmers only considered their sheep to be hungry when on a restricted diet, or when it snowed. They did not rate the hunger likely to be experienced every day by hill sheep (Dwyer, personal communication). Perhaps the opinion that hunger is the most acceptable is as a result of the fact that hunger is an everyday occurrence and is usually a pre-requisite of feeding which is a positive behaviour – although hunger in itself is unlikely to compromise welfare, chronic hunger might. Research has demonstrated that animals are motivated to work hard to gain access to particular resources; the more motivated an animal is the harder it is willing to work. Therefore the welfare of an individual animal will be improved with access to that resource (Dixon et al., 2014). Animal behaviour studies have shown that hunger can act as a strong behavioural motivator, with sheep choosing to walk a long distance to reach food (Verbeerk et al., 2011) and broiler breeders performing the aversive task of walking through water to reach a foraging platform (Dixon et al., 2014). It is possible that of the six welfare scenarios 'hunger' was the most relatable as people experience hunger on a daily basis without their welfare being compromised.

An interaction was found between the ratings of the Freedoms and farmer experience; scores declined with experience for all but the provision of 'pain relief', which remained consistent with differing levels of experience. Age and experience were positively correlated. The significant effect of experience may therefore be as a result of age, with individuals' attitudes changing over the course of their lifetime. It may also be as a result of attitudinal changes between generations with individuals from younger generations having more positive attitudes to animal pain and welfare. This cohort effect has been noted within the veterinary profession with more recent graduates showing more positive attitudes to pain and welfare (Capner et al., 1999; Huxley and Whay, 2006; Laven et al., 2009). It is possible that the attitudinal differences seen within the veterinary profession also exist within the farming profession with older or more experienced farmers having less positive attitudes to welfare. If this is the case then the lower Freedom scores assigned by farmers with more experience would be explained. However it does not explain why the scoring for 'pain relief' did not decline as it did for the other five Freedoms. Picking apart the effect of age and experience is difficult and would require longitudinal studies following individuals across their careers.

Consumers have become more aware of animal welfare with improvements in EU legislation occurring over the previous decade, including the ban on animal testing of cosmetic products in 2004, the ban on battery cages for laying hens in 2012, and restrictions being placed on the use of gestation crates for sows in 2013. These changes have occurred in part because of public pressure to improve animal welfare. It is possible that this increased societal awareness and interest in animal welfare has caused a shift in the thinking of farmers with younger generations having greater awareness of, and interest in the welfare of their animals.

5.2 Capacity to feel pain - Do farmers perceive there to be a difference in the capacity of different species to feel pain?

How farmers scored the capacity of different species to feel pain shows a difference in how pain is viewed in humans compared to other animal species. Humans were assigned the greatest capacity to feel pain, followed by similar scores for cattle and sheep and finally turkeys receiving the lowest scores overall. The pain capacity scores given indicate that farmers believe that animals can feel pain, that this pain capacity differs between species, and that a level of pain greater than what humans can experience exists. The differences seen in how the pain capacity of these species was scored could be considered species bias. This bias to attribute capabilities to other species may be based on how the similarity of those species to humans is perceived, which would explain the close proximity of the mammal species' scores and the distance of the avian species score. This phenomenon has been discussed in relation to the phylogenetic tree, with humans being more comfortable assigning shared capabilities to more similar species (Mendl, 2004). Another reason for these results could be familiarity; an individual's familiarity with a species may impact upon how that person views the sentience and abilities of that species (Morris et al., 2012). Here farmers' scores of the pain capacity of cattle and sheep were greater than their scores of turkeys, which may be explained by their familiarity with cattle and sheep and their lack of familiarity with turkeys.

A study of perceptions of animal sentience asked biology students to rate a number of animal species on how alike they were to humans in their capacity to experience: pain, happiness, fear, and boredom (Phillips and McCulloch, 2005). These four scores were combined to create a total perceived sentience score. Monkey, dog and new born baby were attributed with 80, 79, and 77% of human sentience while fox, pig and chicken were attributed with 67, 65, and 59% of human sentience. These results demonstrate differences with regard to how these students perceived the sentience levels of these species. Not surprisingly monkey and human baby were rated as most similar to humans. Perhaps of interest is the high similarly attributed to dog especially in comparison to the lower rating of fox. The authors suggest that the high rating of dog may be attributable to peoples' familiarity with dog emotions that appear similar to their own. Ratings of sentience for pigs and chicken by British students were significantly correlated with attitude statements about space restriction (pigs) and battery cages (chickens) with higher sentience ratings being given by those with more positive attitudes, demonstrating a relationship between peoples' attitudes to the use of an animal and its sentience capacity. The low rating of chicken sentience, at 59% percent of human, is similar to the difference reported in this study in how the capacity of turkeys and humans to feel pain was scored, with respective mean of 59 and 80.

A significant effect of experience was found for how farmers scored the capacity of different species to feel pain, with lower scores given by those with more experience. As discussed in the Freedom section, this effect could be explained by views changing with age, or as a result of differences between cohorts in how the sentience of animals is viewed.

5.3 Attitudes towards pain and analgesic use - What are farmers' attitudes to pain and analgesic use?

The results from the attitude statements can be discussed in three separate ways: factor score, individual statements, and the relationship between factor score and the 'pain relief' Freedom.

5.3.1 Individual statements

Ninety three percent of farmers agreed that *'farm animals benefit from pain alleviation'* which is a similar finding to other studies that assessed the views of cattle farmers and vets: 98% of UK vets (Whay and Huxley, 2005), 100% of Finnish vets, (Raekallio et al., 2003), 96% of Scandinavian vets (Thomsen et al., 2010) and 94 and 99% of Danish farmers and vets respectively (Thomsen et al., 2012). Demonstrating the positive view that pain alleviation benefits the animal.

Only 8% percent of farmers agreed that '*some degree of pain is beneficial to the animal*', which is considerably lower than the 43% of Swiss farmers (Becker et al., 2013) and 35% of Finnish vets (Raekallio et al., 2003) that agreed with a similar statement. Our finding is more comparable to that of a Danish study were 10% of farmers and 16% of vets agreed (Thomsen et al., 2012), and a Brazilian study where 3% of vets agreed (Lorena et al., 2013). It is worth noting that the wording of the statement differs between all these studies and ours in that they all specify what the benefit is: reduced movement by the animal.

Eighty-two percent of farmers agreed that animals recover better when given pain relieving drugs which is comparable with the literature: 91% of UK vets (Whay and Huxley, 2005), 82% of Finnish vets (Raekallio et al., 2003), 87 and 92% of Swiss farmers and vets respectively (Becker et al., 2013), 73% of Brazilian vets (Lorena et al., 2013) and 72 and 94% of UK farmers and vets (Ison and Rutherford, 2014). Fourteen percent of farmers agreed that '*it is difficult to recognise pain in farm animals*' which is considerately lower than the respective 33 and 40% of UK pig farmers and vets (Ison and Rutherford, 2014) and the 40% of Finnish cattle vets (Raekallio et al., 2003) that agreed with the same statement. Twelve percent of farmers agreed that '*pain relief drugs are too expensive to use regularly*'. This is a similar level of agreement as found in the literature, with 19% of UK pig farmers (Ison and Rutherford, 2014) and 11% of Swiss cattle farmers (Becker et al., 2013) agreeing that the expense of pain relief drugs is a concern for them. However 78% of farmers also agreed that they were '*happy to pay the cost involved with giving pain relieving drugs*', similar to Swiss cattle farmers, 74% of whom agreed they were '*willing to pay the costs of analgesics for their dairy cattle*'.

Overall these results indicate that positive views are held; they point to the fact that farmers are aware that animals feel pain, that pain is a negative experience and pain alleviation is beneficial. However evidence still suggests that pain goes unmitigated (Huxley and Whay, 2006; Rutherford et al., *in prep*). A situation that is unlikely to be improved when no analgesic drugs are licenced for use in sheep (Lizarraga and Chambers, 2012; Scott, 2013 p.214). Eleven and 16% of cattle and sheep farmers respectively either did not respond, or responded 'neither agree nor disagree' to the statement, '*farm animals recover better from an injury, disease or painful procedures when given pain relief drugs*'. A similar result was found by Ison and Rutherford (2014) when 20% of pig farmers did not respond or gave a neutral response to '*pigs recover better with pain relief*', perhaps highlighting that for a small percentage of farmers there is a lack of communication with their vet about the benefits of analgesics for their animals.

To my knowledge no previous study has asked farmers about the affect their management practices have on their opportunity to identify and treat pain in their animals. This topic was addressed here using three statements concerning farmers' opportunity to identify animals in pain, time and labour constraints, and the difficulties involved with gathering and handling livestock. A high percentage of both sheep (91%) and cattle (93%) farmers agreed that '*the current management of animals at my farm offers sufficient opportunity to identify animals in pain'.* The similarity in agreement between the sheep and cattle farmers is perhaps surprising as most cattle will be housed for a large proportion of the year and farmers will have daily contact with them during this time. In contrast in most sheep systems sheep will either be housed for only short periods or not housed at all and farmers will have less daily contact with their animals. The similarity between the levels of agreement between the two groups is lower for the other two statements. Almost a third more sheep farmers agreed that '*providing pain relief is impractical most of the time as a result of the need for increased time and labour*' and that '*difficulties with gathering and/or handling means that is it difficult to administer pain relief*', indicating that sheep farmers find the limitations of time and labour, and gathering and handling a greater constraint than do cattle farmers.

5.3.2. Attitudes to pain in livestock - Factor Scores

Each participant was assigned an attitude factor score based on how they responded to nine attitude statements. Cattle farmers had significantly higher factor scores than sheep farmers. This means that overall cattle farmers expressed a higher level of agreement with positively phrased statements and a lower level of agreement with negatively phrased statements about pain and analgesic use. Sheep farmers were less decisive in their responses than cattle farmers, being more likely to either not answer a question, or answering with 'neither agree nor disagree'.

The nine statements can be divided up into three main types: management, cost and general attitudes to pain. There were four statements concerned with general attitudes to pain, 87% of cattle farmers and 84% of sheep farmers gave positive responses to these statements. There were three statements about the effect management had on the use of analgesics, 77% of cattle farmers and 70% of sheep farmers gave positive responses to these statements. There were two statements pertaining to the cost of analgesics, 73% of cattle farmers and 65% of sheep farmers gave positive responses to these statements. Therefore the greatest differences between cattle and sheep farmers were for the statements concerning cost and management, with general attitudes to pain having the smallest difference. These results indicate that cost and management are greater barriers for sheep farmers than for cattle farmers. This could be explained by the higher value of individual cattle compared to sheep; cattle are more expensive to replace and therefore the cost of pain relief is lower relative to the value of the animal in comparison to sheep. In addition cattle are larger and are generally more capable of causing more serious injury than are sheep therefore the desire to limit pain may be driven by the concern for the safety of the individual treating the animal. In a study of

Swiss cattle vets 44% agreed that '*an important reason for administering analgesia in dairy cattle during painful interventions on their feet is the reduced risk of injury by defensive movements for the person performing this procedure*' (Becker et al., 2013). There may also be a relationship difference between how cattle farmers view their cattle and how sheep farmers view their sheep, with the greater degree of human-animal interaction that is likely to occur in cattle farming facilitating the development of a more positive association between farmer and animal.

5.3.3. Attitude to pain in livestock & 'Pain Relief'

An analysis of a relationship between attitude group and the pain relief scenario from the Five Freedoms section revealed no differences between the three groups for females, however for males all three groups were significantly different from each other. Males with high attitude scores rated 'pain relief' the highest, and those with low attitude scores rated it the lowest. Although only 14% of participants were female, the percentage of males and females in each attitude group were very similar with the majority of participants being in the high attitude group irrespective of gender. When comparing each gender attitude group it was the low scoring males who scored 'pain relief' significantly lower than the other five groups showing that the males in the low attitude group rated the importance of pain relief provision the lowest. These results indicate a relationship between farmers' attitudes to pain and analgesic use and how acceptable they think it is for pain not to be treated. Though this relationship is only seen within the male population, as the majority of farmers are male, this may have significant implications for the treatment of pain and therefore welfare.

5.4 Pain ratings for conditions and procedures - Is there a relationship between farmers' attitudes to pain and analgesic use and how farmers rate the pain associated with different conditions and procedures?

Pain ratings ranged across the entire scale with the exception of lameness in cattle, mastitis in sheep, and difficult lambing and calving where no one gave a 'no pain' rating. A wide range of pain scores was also reported by Huxley and Whay (2006), Laven et al. (2009) and Muri et al. (2012). Huxley and Whay believe that it supports the idea that pain is difficult to assess, and Laven and colleagues state that it highlights the subjective nature of pain estimates. The large range in pain ratings is perhaps of further interest when viewed in light of participants' strong belief in their own ability to assess pain, with over 91% rating their assessment skills as either, good, very good or excellent. Of potential concern is that fewer participants rated their knowledge of how to control pain as good, very good or excellent. There was a decline of 9 and 14% respectively for cattle and sheep farmers, with 83% of cattle farmers considering their knowledge as good, very good or excellent, compared to 75% of sheep farmers.

Difficult lambing and calving were considered to be the most painful conditions, yet a study of lambing management in the UK found that only 6% of ewes presenting with dystocia received veterinary attention (Scott, 2003) and 23% of UK vets never used anaesthetics or analgesics for difficult calving (Huxley and Whay, 2006). Normal lambing and calving were among the least painful conditions and procedures, along with ear marking and tail docking. A gender effect was found for the pain rating of normal and difficult calving with females scoring them significantly higher than males. A similar effect was found for pig pain, with females rating normal and difficult farrowing higher than did males (Ison and Rutherford, 2014). This gender effect was not seen in the pain ratings of lambing. Raekallio et al. (2003) found that females and younger vets generally rated pain higher. Ison and Rutherford also (2014) found that age affected how farmers and vets rated the pain associated with a number of conditions including farrowing, both normal and difficult, as well as gastrointestinal disease and a broken leg. Laven et al. (2009) found that female respondents and more recent graduates tended to give a higher pain score for most conditions. This current research also found a significant interaction between gender and attitude group for the pain rating of caesarean section. Females were relatively consistent in how they rated the pain regardless of their attitudes to pain and analgesic use. In comparison males showed significant differences with those with the most positive attitudes rating pain the highest and those with the least positive attitudes rating pain the lowest. Throughout the whole analysis a number of gender differences were found, however no consistent pattern was seen. This highlights the difficulty of identifying true gender differences as there are likely to be other factors playing a role. In studies like these it can be especially difficult due to the pre-existing skewed gender population that exists in the farming world. However if gender does play a role in how farmers perceive pain in their animals this may have implications for animal welfare as the majority of farmers are male.

Muri et al. (2012) found that having experience of a large number of conditions was negatively associated with pain ratings, i.e. more experienced farmers rated pain lower, as was growing up on a goat farm and having farming as the main source of income. In a study (Thomsen et al., 2012) on perceptions of pain, Danish farmers rated the pain associated with a number of conditions the same or significantly higher than did vets. This was with the exception of bovine uveitis where farmers gave a lower rating. The authors suggest that this may be as a result of the rarity of this disease and therefore the likely lack of experience farmers had with it. Our research found an effect of the number of years of experience farmers had of working with cattle and the pain ratings given for caesarean section, with those with more experience rating pain lower. Caesarean sections may have become more common place in recent years and it is possible that older farmers would not have had much experience of them in the past. This lack of familiarity or experience with the procedure may have resulted in the lower pain ratings given by more experienced farmers. However a comparison of the pain ratings assigned by UK (Huxley and Whay, 2006) and New Zealand (Laven et al., 2009) cattle vets for the presence of a left-displaced abomasum (LDA) found that UK vets assigned a significantly lower pain score compared to New Zealand vets. The authors suggest this difference is as a result of New Zealand vets lack of familiarity with the condition. The relationship between experience and pain ratings is unclear, possibly as a result of the different types of experience investigated. For example experience of a particular condition or procedure, general experience of painful conditions or procedures and experience in terms of the length of time an individual has worked with a species.

The analyses revealed a relationship between farmers' attitudes to pain and analgesic use, and the pain ratings assigned to a number of conditions and procedures. Where a significant relationship between attitudes to pain and analgesic use and pain ratings occurred it showed that those participants with the highest attitude scores rated pain the highest. In cattle this was seen in pain ratings of castration, caesarean section, mastitis and the combined pain score, and for pregnancy toxaemia in sheep. Similar relationships between attitudes to pain in livestock and pain ratings can be seen in the literature. For example, a study of dairy farmers found that the odds of a farmer agreeing with the statement '*animals experience physical pain as humans do*' increased when the farmer also had a higher mean pain rating (based on 21 conditions) (Kielland et al., 2010). Also a study of Finnish dairy cattle farmers found that farmers with more positive attitudes towards disbudding (as assessed using a number of attitudinal statements) also rated the pain associated with a number of conditions higher (Wikman et al., 2013). More positive attitudes to animals in general have also been shown to influence pain ratings. For example a study on pain perceptions of dog owners (Ellingsen et al., 2010) found that those with more positive attitudes to pets (as assessed using a multi-item pet attitude scale (Templer, 1981)) rated pain higher. In addition a study on pain assessment in goat farmers found that farmers that had scored highly on attitudinal items describing goats as pleasant animals rated pain more highly (Muri et al., 2012).

Although significant effects of attitude group, experience and gender were found for the pain ratings of a number of cattle conditions, no interactions between these variables were found. This is in contrast to the sheep pain ratings, where significant interactions were found between attitude group and experience for the pain ratings of castration, tail docking and combined pain score, and between attitude group and gender for the pain rating of caesarean section. Where an interaction has occurred between attitude group and experience, experience seems to mitigate the effect of positive attitudes with those with more positive attitudes rating pain lower if they are experienced.

6. Conclusion

This study has aimed to garner an understanding of how livestock farmers view pain in their animals. This is the first time a study such as this has been conducted on sheep farmers and as such offers new insight into farmers' views on pain and analgesic use in farm animals.

A comparison of cattle and sheep farmers was made possible, and differences in attitudes were revealed, with cattle farmers having more positive attitudes to pain and analgesic use than sheep farmers. It is proposed here that these attitudinal differences are as a result of management and economic differences between these two farming systems. In addition fewer sheep farmers rated their knowledge of pain management as good, very good or excellent in comparison to cattle farmers. Sheep farmer knowledge of pain management would likely be improved through communication with vets. However this will come at an additional financial cost to the farmer and findings of this study suggest cost is perceived to be a greater barrier for sheep farmers than it is for cattle farmers.

Results indicate that farmers do view the acceptability of different potential welfare compromises differently. Although all six of the welfare considerations presented to farmers were deemed important, the prompt treatment of disease and the provision of pain relief were considered the most important. This high rating of the importance of the provision of pain relief is of interest when research has shown that much of livestock pain goes unmitigated.

Farmers do perceive a difference in the capacity of different species to feel pain, with turkeys being perceived as having a lower pain capacity than cattle and sheep, which in turn are perceived as having a lower pain capacity than humans. Perceived differences between species in their ability to experience pain is likely to have implications for pain management.

Overall farmers have positive attitudes to pain and analgesic use in livestock. The large majority of farmers agreed that pain alleviation is of benefit to farm animals, and disagreed that pain relieving drugs were not necessary. As in other studies cost was not deemed to be the barrier it is assumed to be, but was considered to be an issue by a greater number of sheep farmers than cattle farmers. This may be due to differences in management practices between cattle and sheep farms. It may also be as a result of the greater cost to sheep farmers relative to the value of the animal.

As in other studies, pain ratings for different conditions were highly variable. Attitudes to pain and analgesic use, gender and experience were found to have effects on the pain ratings of a number of conditions and procedures; with there being a tendency for females, those with fewer years farming experience and those with the most positive attitudes to pain and analgesic use being more likely to assign higher pain scores. This may have subsequent implications for pain mitigation.

Chapter 3 Students' views on animal sentience, pain and welfare

Abstract

An online questionnaire on attitudes to animal welfare was completed by 2,530 students studying animal related subjects at seventeen academic institutions across the UK and the Republic of Ireland. The questionnaire utilised the Five Freedoms animal welfare framework to assess students' perceptions of the importance of various welfare requirements. Overall the need for prompt treatment and the provision of pain relief were considered the most important and hunger the least important welfare considerations. Students' views on animal sentience were assessed using the belief in animal mind (BAM) scale and their perceptions of how a number of animal species (fish, chickens, sheep, cattle, pigs, dogs, horses, humans) differed in their capacity to feel pain. Fish were perceived as having the lowest and humans the highest pain capacity. However, there were differences between courses in how the pain capacity of the other six species was perceived. For example agriculture and vet nursing students considered sheep, cattle, pigs and horses to have similar pain capacities whereas vet students perceived pigs and horses as having significantly higher pain capacities than sheep and cattle. Overall students had positive attitudes to pain in livestock with 86% agreeing that *'farm animals benefit from pain alleviation'* and 92% disagreeing that '*pain relieving drugs are not necessary for farm animals'*. Responses to four attitude statements concerning pain and the use of analgesia in livestock (APL), and four statements concerning belief in animal mind (BAM) were analysed using principal component analysis (PCA). This revealed one APL and one BAM dimension with high internal

reliabilities as assessed by Cronbach's alpha. This enabled the calculation of a single factor regression score for each participant for APL and BAM allowing for further analysis using linear models. Results found that females and older students had the most positive attitudes to pain in livestock and the strongest belief in animal mind. The views of students, especially agriculture and veterinary students, towards farm animals and their welfare is of great importance as research has found a relationship between attitudes and behaviour, with individuals with more positive attitudes having more positive interactions with animals.

1. Introduction

The Five Freedoms is a welfare framework developed by the Farm Animal Welfare Council (FAWC), based on the original work of the Brambell committee in 1965 (Brambell, 1965b) which recommend that animals should have the freedom to stand up, lie down, turn around, groom themselves and stretch their limbs. The Five Freedoms has been adopted by a number of organisations such as the RSPCA as part of their farm animal welfare guidelines. The Five Freedoms however are a conceptual ideal and it may be impossible to ensure all of the Freedoms all of the time. For example in the livestock industry there is often a conflict between the freedom to express normal behaviour and the freedom from hunger or thirst. Extensively reared animals are often perceived as having higher welfare than intensively reared animals as they have more behavioural freedom and are viewed as having a more natural life (FAWC, 2011a). However there is a greater risk to animals in extensive systems not receiving treatment for an injury or disease due to lower levels of contact between the animals and stockpersons (Dwyer, 2009). Therefore the system in which animals are kept will dictate to some degree what welfare compromises they are likely to be exposed to. Understanding how farmers view these trade-offs may be important for the welfare of the animals in their care. Freedom from pain is an extremely important component to any being's welfare (Anil et al., 2002). Pain has the potential to negatively impact both physical and mental health (Viñuela-Fernández et al., 2007), and can greatly increase recovery time from the initial condition (Hewson et al., 2007a; Muir and Woolf, 2001) In spite of the welfare implications, pain is a commonly overlooked component of farm animal welfare. As attitudes play an important role in behaviour, assessing views towards pain and analgesic use in livestock will enable a better understanding of the potential barriers to its use.

Belief in animal mind, or animal sentience is one's belief about the emotional lives of animals, the capacity to which they can think and experience feelings and emotions; these beliefs are likely to be important in the formation of attitudes towards animals (Hills, 1995; Knight et al., 2004) and how people interact with and treat them (Morris et al., 2012). Belief in animal mind was found to be a strong determinant of attitudes towards animals (Herzog and S, 1997; Knight et al., 2004) and has been found to positively correlate with concern for animal welfare (Broida et al., 1993). The capacity to feel pain is an inherent part of being a sentient individual, and as such peoples' perceptions of animals' capacity to experience pain has been used as a way of discussing and assessing peoples' views on animal sentience (Heleski, 2004; Herzog and S, 1997; Paul and Podberscek, 2000; Phillips and McCulloch, 2005).

Farmers and veterinarians are two cohorts that are likely to have the greatest impact on the welfare of farmed animals. As the farmers and vets of tomorrow the attitudes that agriculture and veterinary students develop during their education is paramount to how they will interact with and treat the animals in their care in the future. Assessing these attitudes during their educational careers enables the identification of areas where improvements could be made. The main premise of this study was to assess the attitudes of agriculture, veterinary and veterinary nursing students towards pain in animals and to identify any differences therein. In addition the attitudes of students from other animal related fields were also assessed to provide a point of comparison.

Aims & Research Questions:

The aim of this research was to assess the attitudes of students studying animal related subjects, to farm animal welfare and sentience.

1. Do course, age, or gender affect:

   i) How students rate the importance of the Five Freedoms?

   ii) How students view the capacity of different species to feel pain?

   iii) Students' attitudes to pain in livestock?

   iv) Students' belief in animal mind?

2. Does experience of a species affect how the pain capacity of that species is viewed?

3. Do attitudes towards pain and belief in animal mind differ between years of study?

2. Methods

2.1 Overview

An online questionnaire was made available to students studying animal related subjects from seventeen educational institutions within the UK and the Republic of Ireland. The questionnaire was designed to assess the views of students to farm animal welfare with the primary focus being on sentience and pain.

2.2 Development

The questionnaire was a shortened version of the farmer questionnaire described in chapter two. Four of the ten attitude statements about pain and analgesic use from the farmer questionnaire were used. The other statements were not applicable to a student cohort as they concerned on-farm practices. The capacity to feel pain section was expanded to include four additional species: dogs, horses, pigs, and fish to further investigate the potential perceived differences across animal groups. In addition turkeys were replaced with chickens as students were likely to be more familiar with chickens than turkeys. Items developed to assess peoples' belief in animal mind were also included (Hills, 1995). The questionnaire was piloted by final year agricultural students at SRUC, and members of the Veterinary Ethics Forum – a Facebook group set up and run by students at the University of Edinburgh veterinary school, for the purpose of organising ethical discussions and other events to encourage thinking on issues surrounding animal science. Students were requested to provide feedback on the length of the questionnaire, the style of questions and the ease of use and comprehension. This feedback was used to improve the questionnaire prior to the start of the study. The questionnaire received internal ethical approval from the School of Health in Social Science at the University of Edinburgh, and external approval from the: Human Ethics Review Committee at the Royal Dick School of Veterinary Studies, the Committee of Research Ethics at the University of Liverpool and the School of Health and Science Ethics Committee at the Dundalk Institute of Technology. The questionnaire was developed in an online html format using snap surveys® software, and was hosted on an external server: snap webhost. The questionnaire is included in Appendix III (undergraduate) and IV (postgraduate)

2.3 Recruitment

The websites of *Undergraduate Courses at University and College* (UCAS) in the UK and the *Central Applications Office* (CAO) in Ireland were utilised to generate a list of educational institutions in the UK and Ireland that offered courses in agriculture, veterinary medicine or veterinary nursing. The search terms used were: 'agriculture' and 'veterinary'. A total of twenty-six educational institutions were identified. Where possible, email addresses of course leaders were obtained from institutional websites, who ran any animal related courses that institution offered including: agriculture, biology, equine studies/science, animal behaviour/care/management/welfare/science. Seventeen institutions agreed to allow their students to participate. Based on the numbers of students enrolled on each of the courses - information provided by course leaders - the recruitment email was sent to 7,896 undergraduate students. A total of 2,562 undergraduate students participated, of these 32 responses were removed as they had omitted or given incorrect information regarding the subject they studied.

Using known contacts of members from the animal behaviour and welfare team at SRUC six academic institutions in the UK running post graduate courses in animal welfare were identified and contacted. Four agreed to allow their students to participant in the study. Based on the numbers of students enrolled on each of the courses, and information provided by course leaders, the recruitment email was sent to 209 postgraduate students.

2.4 Distribution

A web-link to the questionnaire was distributed to students by faculty members within each institution. The email contained information about the study along with a web-link. Students were offered the opportunity to be entered into a prize draw to win one of five £50 Amazon vouchers. Participation was via self-selection, with those not wishing to take part not completing the questionnaire. The questionnaire was live for four months; between September and December 2013. In addition post graduate students were also recruited in March 2015. A reminder email was sent two weeks after the initial email. At the end of the four month period the questionnaire was closed and the responses downloaded.

2.5 Questionnaire

2.5.1 Freedoms

Participants were asked to rate how acceptable it was for farm animals to sometimes be denied each of the Five Freedoms (Table 3.1). The 'freedom from pain, injury of disease by prevention or rapid diagnosis and treatment' was split into two questions, one pertaining to prompt treatment and one to the provision of pain relief to animals in pain. These questions were answered on a 100mm visual analogue scale (VAS) with an anchor at either end of the scale, of '*strongly agree*' and '*strongly disagree*'. Participants were asked to place a downward line through each of the scales at the point they felt best represented their level of agreement with the six different statements. Therefore answers towards the 'strongly disagree' end of the scale represented positive attitudes towards that Freedom. The order these six statements appeared in was randomised for each student to prevent order bias.

Table 3.1 Welfare statements based on the Five Freedoms Animal Welfare Framework

It is acceptable if:	Referred to as:
farm animals are sometimes hungry	'hunger'
farm animals sometimes don't have shelter and a comfortable resting area	'shelter'
sick farm animals are not always treated promptly	'prompt treatment'
farm animals in pain are not always given pain relief	'pain relief'
farm animals are not always able to express normal behaviour	'normal behaviour'
farm animals sometimes experience fear or distress	'fear & distress'

2.5.2 Capacity to feel pain

Participants were asked to rate different species (humans, sheep, cattle, pigs, dogs, horses, chickens and fish) in their capacity to feel pain on a 100mm VAS with anchors at either end: '*Feels no pain*' and '*Capacity to feel the worst pain*'. Participants were asked to place a downward line through each of the scales at the point they felt best represented each species' capacity to feel pain. The order these eight species appeared in was randomised for each student to prevent order bias.

2.5.3 Attitudes to pain in livestock (APL)

Participants were asked to rate their level of agreement with four statements about pain in farm animals on a 5 point Likert scale: '*Strongly agree*', '*Agree*', '*Neither agree nor disagree*', '*Disagree*', *Strongly disagree*'. The statements were chosen and developed to assess general attitudes to pain in livestock. Two of these were based on statements that had been used in previous studies that had investigated attitudes to pain in cattle (Table 3.2). In addition two statements that had been used in a similar study on farmers' attitudes to pain in livestock were included. The order these four statements appeared in was randomised for each student to prevent order bias.

Table 3.2 Attitudes towards pain statements adapted from the literature

Statements	Studies
Farm animals benefit from pain alleviation	(Raekallio et al., 2003; Thomsen et al., 2012, 2010; Whay and Huxley, 2005)
Some degree of pain is beneficial to the animal	(Raekallio et al., 2003; Thomsen et al., 2012)
Pain relieving drugs are not necessary for farm animals	Farmer questionnaire
It is difficult to recognise pain in farm animals	Farmer questionnaire

2.5.4 Belief in animal mind (BAM)

Participants were asked to rate their level of agreement with four statements pertaining to animal sentience. This was done on a 5 point Likert scale: '*Yes definitely*', '*Yes probably*', '*Possibly to a limited extent*', '*No probably not*', '*No definitely not*'. A '*Don't know*' option was also provided. These four statements were developed by Hills (1995) to study peoples' attitudes towards the mental experiences of animals. The order these four statements appeared in was randomised for each student to prevent order bias.

2.5.5 Demographics

Participants were asked to provide demographic information about themselves and their course: age, gender, academic institution, and course of study. Participants were also asked what animal species they had experience of working with outside of their academic studies. A list of seven species was provided (sheep, cattle, pigs, dogs, horses, chickens, fish) and an open response text box was also included for additional species.

3. Data & Statistical Analysis

3.1 Data

Data were downloaded from the webhost into snap survey software where they were then exported into Excel. APL and BAM statements were recoded to reflect the direction of attitude. Positively orientated statements were coded so that the highest score of '5' was assigned to 'strongly agree/yes definitely' and the lowest score of '1' to 'strongly disagree/no definitely not'. For negatively orientated statements the opposite applied with 'strongly agree/yes definitely' answers being assigned a score of '1' and 'strongly disagree/no definitely not'' statements a score of '5'. This resulted in high scores representing more positive, and low factor scores representing less positive attitudes to pain in livestock.

3.2 Analysis

Statistical analyses were carried out in Genstat (16th Edition) (REML and Spearman rank correlations) and SPSS (22nd Edition) (Principal Component Analysis (PCA), and Cronbach's alpha). Main effects were considered significant at $p<0.05$; interactions at $p<0.01$. Data were found to be normally distributed as assessed by inspection of the residuals. REML was utilised for statistical analysis as it is a robust analogue of ANOVA which aims to discover how an experimental outcome is affected by various factors, allowing for the investigation of fixed effects on result outcomes. REML, unlike ANOVA does not require a balanced design and is well suited for non-experimental studies with unequal group sizes such as this one. Main effects and two-way interactions were investigated. If interactions were not statistically significant they were removed from the model and the model re-run until the simplest model was achieved, i.e. only the main effects and significant interactions remained. Post hoc analyses were conducted using least significant difference (LSD) tests.

3.2.1 Freedoms & Pain Capacity

Analysis was conducted using REML. Freedoms and pain capacity data were separately fitted as response variates. Freedom or species, age, course and gender were all fitted as fixed effects. All fixed effects were factors. Participant number was fitted as the random effect in the model.

3.2.2 Attitudes& Belief in Animal Mind

Exploratory PCA allows for a large number of variables, in this case the statements from the APL and BAM scales, to be reduced into a smaller number of components (component reduction). To ensure the data met the assumption of PCA two tests were run: the Kaiser-Meyer-Olkin measure of sampling adequacy indicated that the items in the attitudes scale had adequate commonalities to warrant component analysis, as did the Bartlett's test of sphericity which showed that there were adequate correlations between items. Initially eigenvalues above 1.0 were extracted, resulting in two components from each scale. Parallel analysis was then conducted to ascertain the statistically significant eigenvalues. Parallel analysis is considered superior to other techniques for identifying the number of components to retain, notably the Scree test or the Kaiser's eigenvalue-greater-than-one rule (Ledesma and Valero-Mora, 2007). Parallel analysis identified one component for the APL scale, and one for the BAM scale. PCA was re-run on the two separate scales, this time extracting one component from the APL scale and one from the BAM scale. Regression factor scores for the two components were generated for each participant. The factor scores are composite variables which provide information about an individual's placements on each of the components (DiStefano et al. 2009), high factor scores represented the most positive attitudes and low scores the least positive.

Cronbach Alpha's test for internal reliability was performed on each scale. This method tests how closely related a set of items are as a group and, whether the items are consistent in what they are measuring. Items with factor loadings below 0.6 were excluded from the scales, resulting in adequate internal reliability. One item '*it is difficult to recognise pain in farm animals*' was removed from the APL scale as its removal increased the internal reliability of the scale.

Analysis of the APL and BAM factor scores was conducted using REML. APL and BAM scores were fitted as the response variate, age and course and gender were fitted as fixed effects, all fixed effects were factors. The relationship between APL and BAM was investigated using Spearman rank correlations.

4. Results

4. 1 Overview

In total 2,421 and 109 useable responses were received from undergraduate and postgraduate students respectively, giving a respective response rate of 32.4% and 52.2% and a total sample size of 2,530. There were significant interactions with course and gender for Freedoms and pain (see sections 4.2 and 4.3 for details), and significant main effects of age, course and gender on APL and BAM, (see sections 4.4 and 4.5 for details). The distribution of students by gender and age for each course is shown in Tables 3.3 and 3.4 respectively.

Table 3.3 Percentage (number) of male and female student participants from each course

	Female	Male	Prefer not to say	No response	Total
ABW PG	3.6 *(n=91)*	0.7 *(n=18)*	0.0 *(n=0)*	0.0 *(n=0)*	4.3 *(n=109)*
ABW UG	4.9 *(n=123)*	0.6 *(n=16)*	0.0 *(n=1)*	0.0 *(n=0)*	5.5 *(n=140)*
Agriculture	7.0 *(n=178)*	6.7 *(n=169)*	0.0 *(n=0)*	0.0 *(n=0)*	13.7 *(n=347)*
Biology	7.5 *(n=189)*	3.4 *(n=86)*	0.1 *(n=2)*	0.0 *(n=0)*	10.9 *(n=277)*
Equine science/studies	3.7 *(n=93)*	0.2 *(n=5)*	0.0 *(n=0)*	0.0 *(n=0)*	3.9 *(n=98)*
Veterinary medicine	45.1 *(n=1142)*	10.0 *(n=253)*	0.2 *(n=6)*	0.1 *(n=3)*	55.4 *(n=1404)*
Veterinary Nursing	5.8 *(n=146)*	0.3 *(n=7)*	0.1 *(n=2)*	0.0 *(n=0)*	6.1 *(n=155)*
Total	77.5 *(n=1962)*	21.9 *(n=554)*	0.4 *(n=11)*	0.1 *(n=3)*	100.0 *(n=2530)*

Table 3.4 Percentage (number) of students participants within each age group

	15-19	20-21	22-24	25+	No response	Total
ABW PG	0.0 *(n=0)*	0.3 *(n=7)*	1.0 *(n=26)*	2.5 *(n=63)*	0.5 *(n=13)*	4.3 *(n=109)*
ABW UG	2.0 *(n=51)*	1.5 *(n=38)*	0.6 *(n=16)*	0.8 *(n=21)*	0.6 *(n=14)*	5.5 *(n=140)*
Agriculture	5.6 *(n=142)*	4.0 *(n=102)*	1.2 *(n=31)*	1.0 *(n=26)*	1.8 *(n=46)*	13.7 *(n=347)*
Biology	4.6 *(n=117)*	4.0 *(n=101)*	0.4 *(n=11)*	0.6 *(n=16)*	1.3 *(n=32)*	10.9 *(n=277)*
Equine science/studies	1.6 *(n=40)*	1.0 *(n=25)*	0.6 *(n=16)*	0.3 *(n=7)*	0.4 *(n=10)*	3.9 *(n=98)*
Veterinary medicine	11.6 *(n=295)*	14.7 *(n=371)*	15.5 *(n=392)*	8.2 *(n=208)*	5.5 *(n=138)*	55.4 *(n=1404)*
Veterinary Nursing	1.9 *(n=48)*	1.7 *(n=44)*	0.9 *(n=23)*	0.8 *(n=19)*	0.8 *(n=21)*	6.1 *(n=155)*
Total	27.4 *(n=693)*	27.2 *(n=688)*	20.4 *(n=515)*	14.2 *(n=360)*	10.8 *(n=274)*	100.0 *(n=2530)*

4.2 Freedoms

A number of significant effects were found on the scoring of Freedoms (**Error! Reference source not found.**). A significant effect ($p<0.001$) of age was found in how the Freedoms were scored, with older participants giving higher scores (Figure 3.1). A significant interaction ($p<0.001$) was found between Freedoms and course with all courses assigning 'hunger' the lowest and 'prompt treatment' the highest scores, but with variation within courses for the scoring of the other four Freedoms (Figure 3.2 & Table 3.6). A significant interaction was found between course and gender ($p<0.001$) in how the Freedoms were scored. Significant differences were found between male and female vet, biology, agriculture and ABW students (Figure 3.3, Figure 3.4, Figure 3.5). A significant interaction was found between gender and Freedoms (p<0.001) with males and females assigning similar scores to 'pain relief' and 'prompt treatment', but with males assigning lower scores than females for the other four Freedoms. However both genders gave the same ranking for the Freedoms (Figure 3.6).

Table 3.5 Effects of age, course and gender on students' scoring of the 'Freedoms'

	wald	f	df	*p*
Freedoms				
Age group	34.46	11.49	2214.9	<0.001
Course.Freedom	161.59	5.39	10938.1	<0.001
Course.Gender	32.03	5.34	2214.4	<0.001
Freedom.Gender	36.15	7.23	10848.7	<0.001

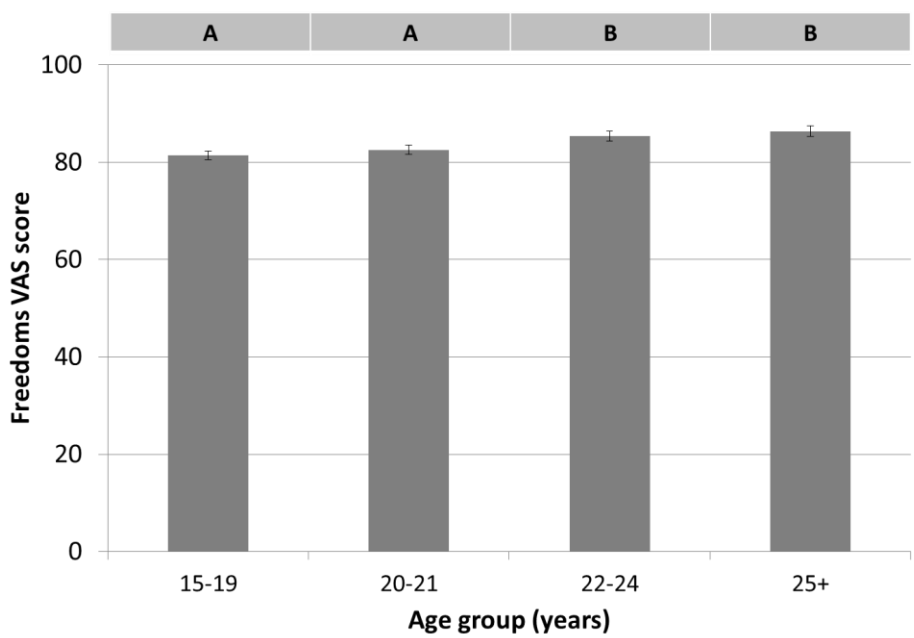

Figure 3.1 Mean (s.e.) Freedom scores for each age group. Age groups that do that share a letter are statistically different from each other at p≤0.05. Student age 22 and over scored the Freedoms higher than those aged between 15 and 21.

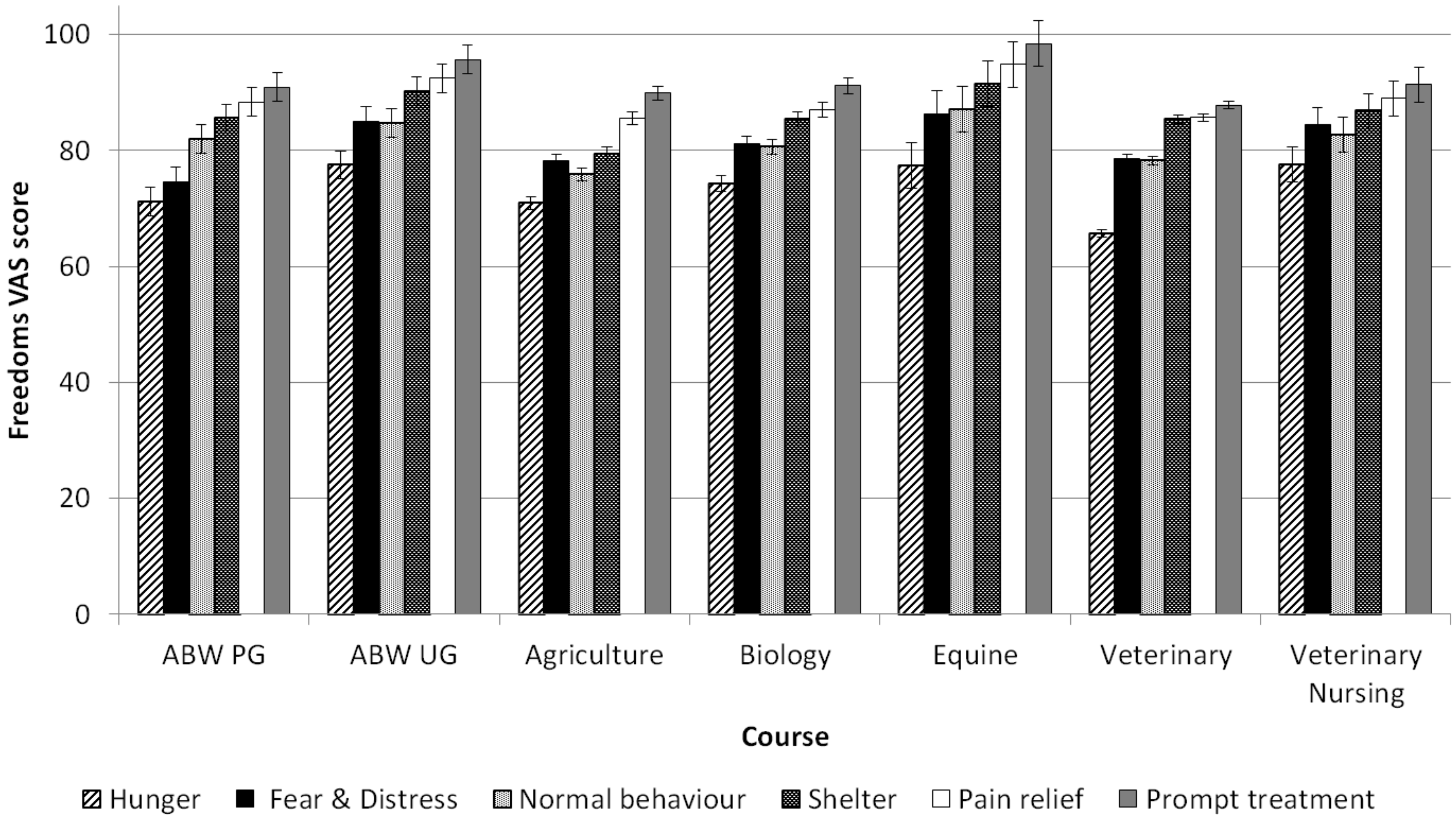

Figure 3.2 Mean (s.e.) scores for each of the six Freedoms for each of the seven courses.

Table 3.6 Comparison of how students from each course rated the importance of each of the Freedoms. Within each course Freedoms that do not share a letter are statistically different from each other at p<0.01.

	Hunger	Normal behaviour	Fear & Distress	Shelter	Pain relief	Prompt treatment
ABW PG	A	B	A	BC	CD	D
ABW UG	A	B	B	C	CD	D
Agriculture	A	B	BC	C	D	E
Biology	A	B	B	C	C	D
Equine	A	B	B	BC	CD	D
Veterinary	A	B	B	C	CD	D
Veterinary nursing	A	B	B	BC	CD	D

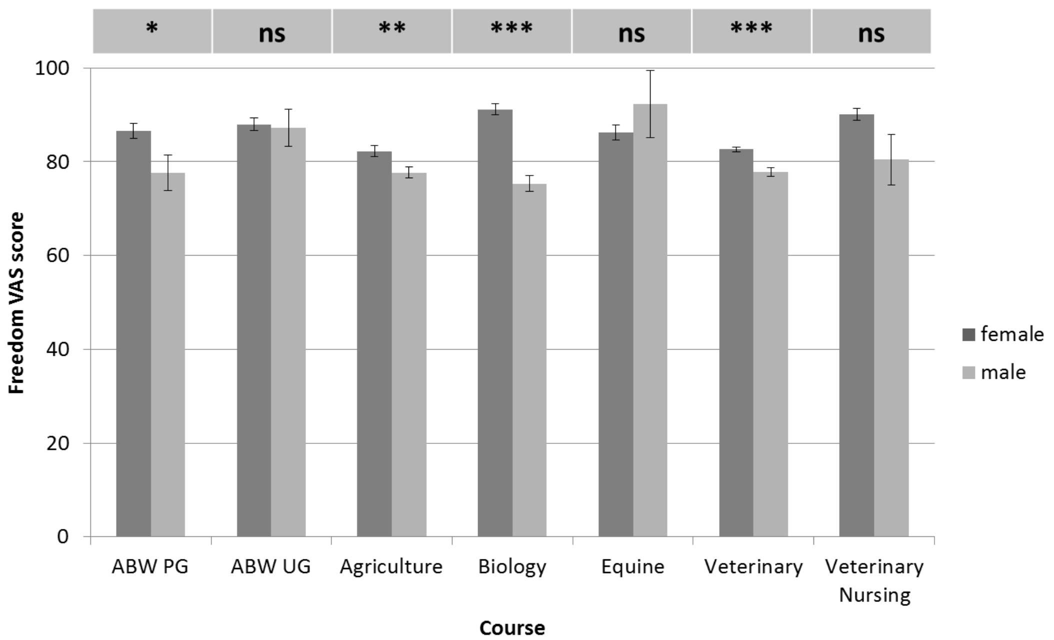

Figure 3.3 Mean (s.e.) Freedom scores for males and females within each course. The asterisks represent significant differences between genders with course.*p≤0.05; **p≤0.01; p≤0.001.

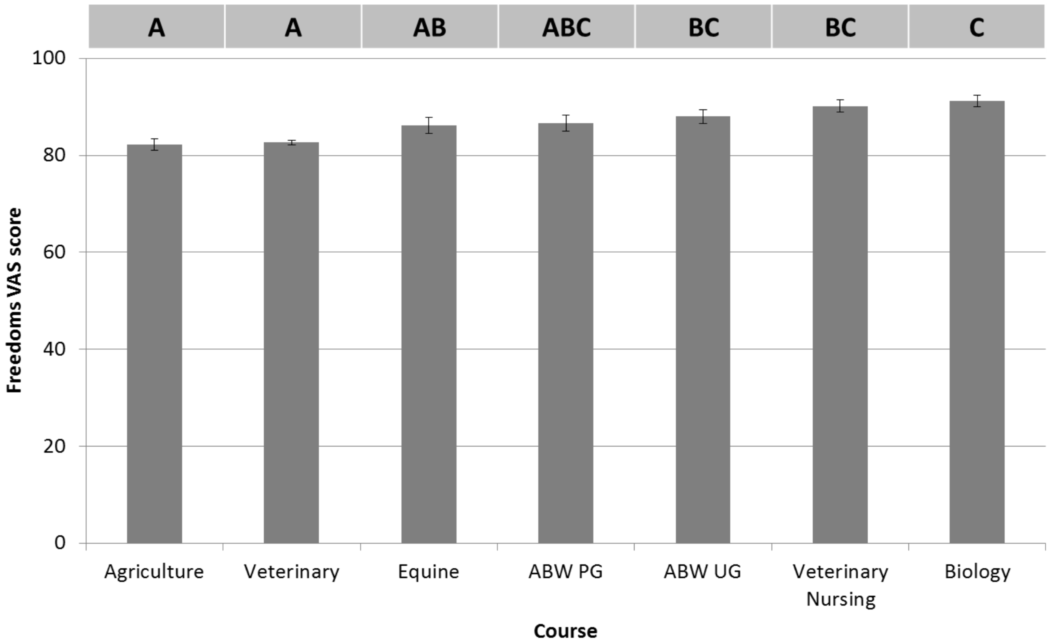

Figure 3.4 Females mean (s.e.) Freedoms scores from each course. Courses that do not share a letter are statistically different from each other at $p<0.01$.

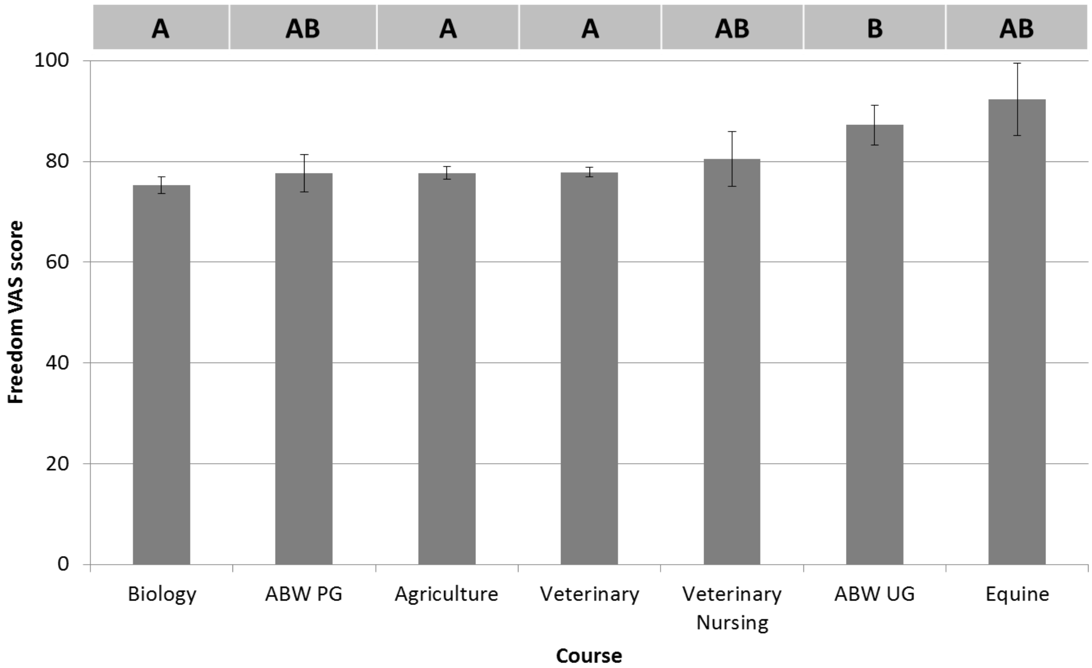

Figure 3.5 Males mean (s.e.) Freedoms score from each course. Courses that do not share a letter are statistically different from each other at $p<0.01$.

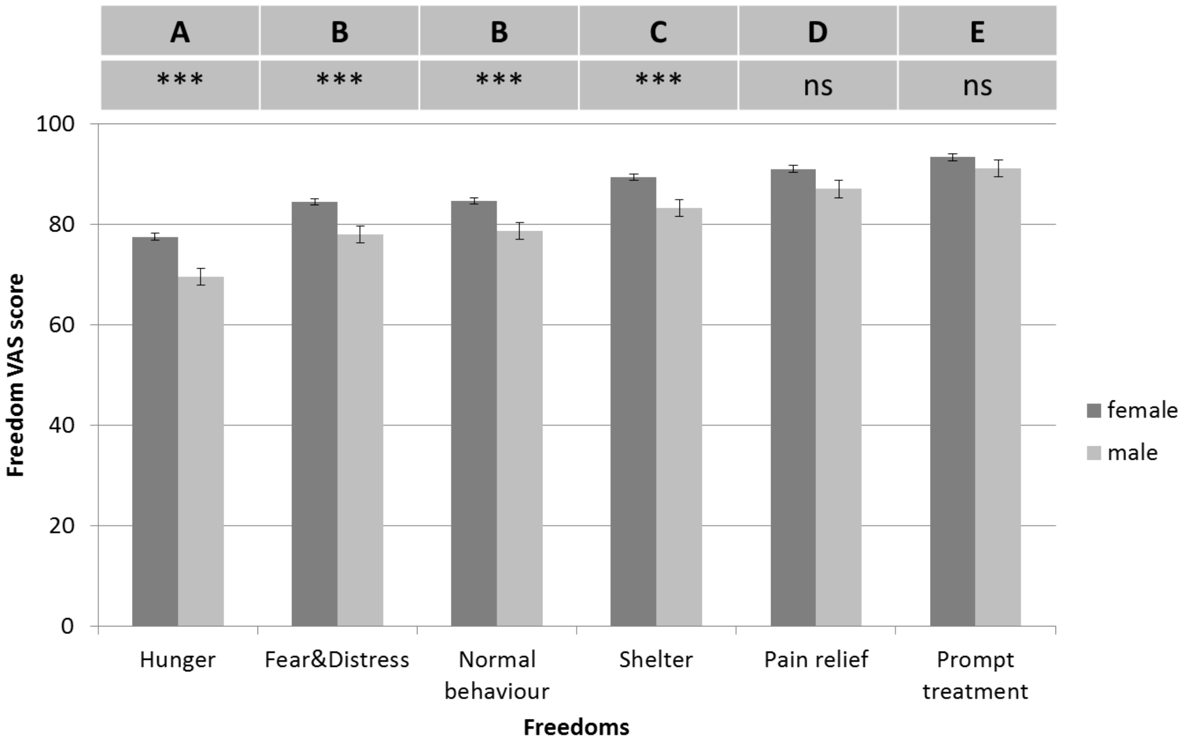

Figure 3.6 Mean (s.e.) Freedom scores for males and females. The letters represent differences between males and females; the asterisks represent differences between Freedoms: *=*p*<0.001. Freedoms that do not share a letter are statistically different from each other at *p*<0.01.**

4.3 Capacity to feel pain

A number of significant effects were found on how pain capacity was scored (Table 3.7). A significant interaction was found between course and species ($p<0.001$) in how students perceive the capacity of animals to feel pain (Figure 3.7). Fish and chickens were perceived as having the lowest capacity to feel pain and humans the highest. However, variations between courses were seen in how similar other species were in their capacity to feel pain. For example, agriculture students scored sheep, cattle, pigs and horses as having a similar capacity but that this capacity was statistically greater than that of fish and chickens and lower than that of humans

(Table 3.8). In contrast, there was a greater amount of overlap between the species for the other student groups.

Table 3.7 Effects of age, course and gender on students' scoring of 'Pain capacity'

	wald	f	df	*p*
Pain capacity				
Age group.Species	58.85	2.80	15183.0	<0.001
Course.Species	196.78	4.69	15183.8	<0.001
Gender.Species	155.04	22.15	15184.4	<0.001

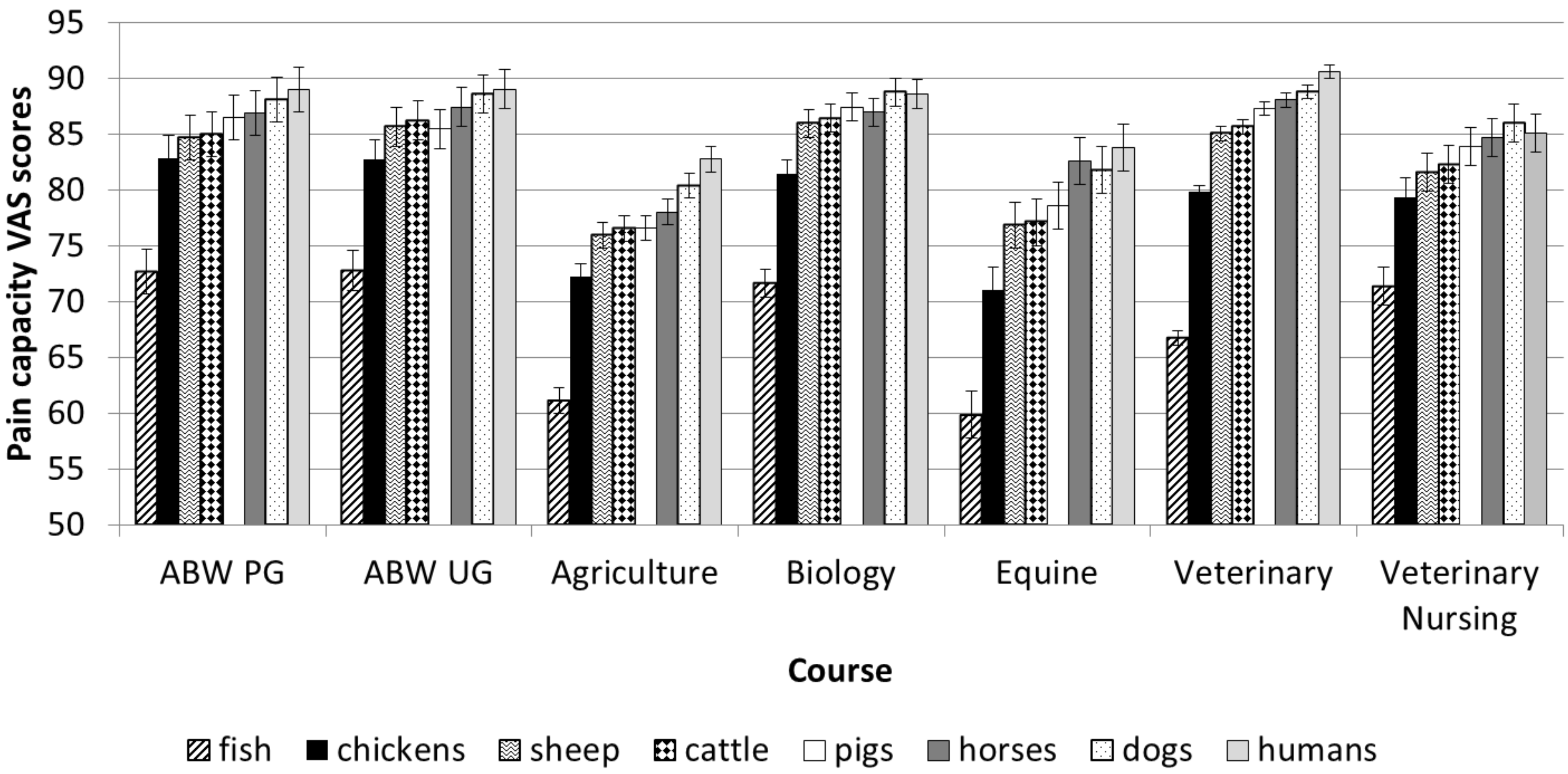

Figure 3.7 Mean (s.e) pain capacity scores for each species for each course.

Table 3.8 Comparison of how each course rated the capacity of each species to feel pain. Within each course species that do not share a letter are statistically different from each other at p<0.01.

	Fish	Chickens	Sheep	Cattle	Pigs	Horses	Dogs	Humans
ABW PG	A	B	BC	BC	BCD	CD	CD	D
ABW UG	A	B	BCD	CD	BC	CD	CD	D
Agriculture	A	B	C	C	C	C	D	E
Biology	A	B	C	CD	CD	CD	D	D
Equine	A	B	C	C	CD	DE	DE	E
Veterinary	A	B	C	C	D	DE	E	F
Veterinary nursing	A	B	BC	BCD	CDE	CDE	E	DE

A significant interaction was found between gender and species ($p<0.001$) in how the capacity to feel pain was scored. Males assigned significantly lower scores than females for all species (Figure 3.8). Females rated sheep, cattle, and pigs as having similar capacities to feel pain in contrast to males who scored pigs as having a higher pain capacity than sheep (Table 3.9). Both genders rated fish the lowest, followed by chickens. Both genders rated dogs, horses and humans as having a similar capacity to feel pain.

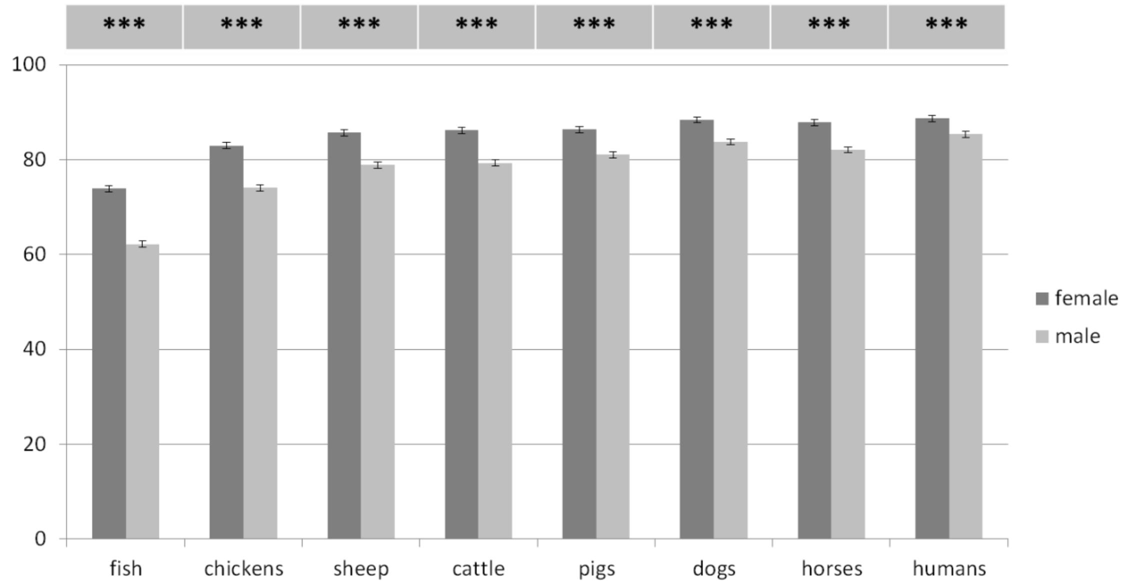

Figure 3.8 Mean (s.e.) pain capacity scores for each species for females and males. The asterisks represent differences between genders. *=*p*<0.001.**

Table 3.9 Comparison of how females and males rated the capacity of each species to feel pain. Within each gender, species that do not share a letter are statistically different from each other at p<0.01.

	Fish	Chickens	Sheep	Cattle	Pigs	Horses	Dogs	Humans
Female	A	B	C	C	C	D	D	D
Male	A	B	C	CD	D	E	E	E

A significant interaction was found between age and species (p<0.001) with 15-19 year old students assigning significantly lower pain capacity scores for each of the species (Figure 3.9 and Table 3.10). The 20-21, 22-24 and 25+ age groups gave similar scores for sheep, cattle, pigs, dogs, horses and humans. However they differed for the pain capacity ratings of fish and chickens with 20-21 giving lower scores.

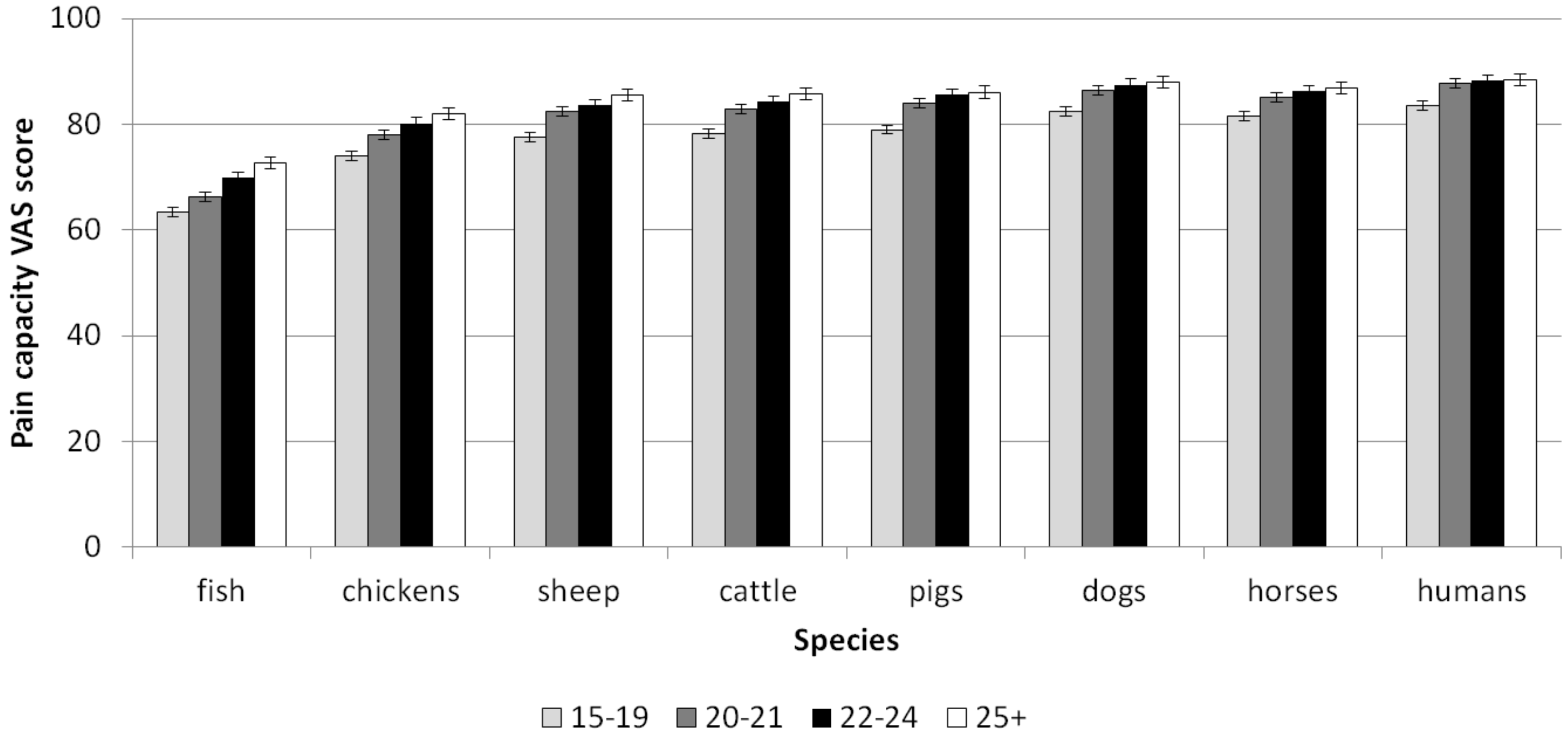

Figure 3.9 Mean (s.e.) pain capacity scores for each species for each of the age groups.

Table 3.10 Comparison of how each age group rated the capacity of each species to feel pain. Within each age group species that do not share a letter are statistically different from each other at p<0.01.

	15-19	20-21	22-24	25+
Fish	A	B	C	C
Chickens	A	B	BC	C
Sheep	A	B	B	B
Cattle	A	B	B	B
Pigs	A	B	B	B
Dogs	A	B	B	B
Horses	A	B	B	B
Humans	A	B	B	B

A comparison between students that did and did not have experience of working with a particular species and the pain capacity scores assigned to that species revealed differences between species. Students that had experience of working with fish, pigs, dogs and horses assigned higher pain capacity scores for these species compared to students who did not have experience working with these species (Table 3.11 and Figure 3.10). In contrast, no difference was found between the pain capacity scores given for chickens, sheep, and cattle regardless of whether students had experience of working with these species.

Table 3.11 Comparison of students with and without experience of working with each of the eight species and the relationship between experience and the pain capacity scores for those species.

Species	wald	f	df	*p*
Fish	15.81	15.81	2412.0	<0.001
Chickens	2.98	2.98	2452.0	0.085
Sheep	0.43	0.43	2466.0	0.512
Cattle	2.85	2.85	2466.0	0.091
Pigs	11.25	11.25	2458.0	<0.001
Dogs	54.41	54.41	2460.0	<0.001
Horses	38.96	38.96	2464.0	<0.001

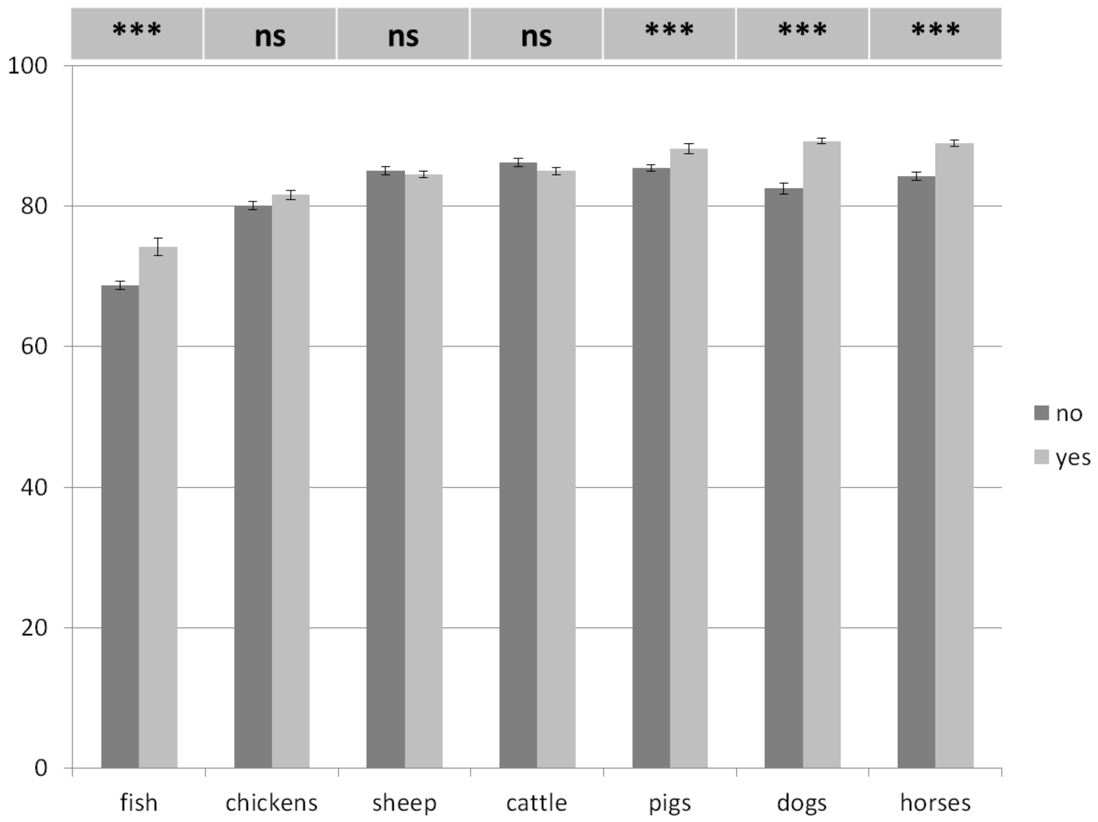

Figure 3.10 Mean (s.e) pain capacity scores for each species based on whether participants had experience of working with that species.

4.4 Attitudes to pain in livestock

Overall students had positive attitudes to pain in livestock with 84% agreeing that *'farm animals benefit from pain alleviation'* and only 8 and 2% respectively agreeing that *some degree of pain is beneficial to the animal'* and '*pain relieving drugs are not necessary for farm animals*' (Table 3.12).

The Kaiser-Meyer-Olkin measure of sampling adequacy (0.579) indicated that the APL statements had adequate commonalities to warrant component analysis. Bartlett's test of sphericity showed that there were adequate correlations (Chi-Sq: 456.9; df: 6, *p*<0.001) between the variables to allow for component reduction. The Cronbach's alpha internal reliability was 0.47 which is considered adequate for a novel psychological scale (Table 3.14).

Significant main effects of age, gender and course were found on the attitudes of students to pain in livestock (Table 3.15). Older students (Figure 3.11) and females (Figure 3.12) had more positive attitudes (higher APL scores). Agriculture students had the lowest APL scores and vet students the highest (Figure 3.13). No differences in APL were found between academic institutions or year of study for agriculture or veterinary nursing students (Table 3.16), however a significant difference was found between academic institutions (Figure 3.14) and across year of study (Figure 3.15) for vet students with APL scores being higher in the students from later years.

Table 3.12 Percentage (number) of students for each level of agreement for 4 statements about pain

	Percentage *(number)*					
Farm animals benefit from pain alleviation	***Strongly Agree***	***Agree***	***Neither agree nor disagree***	***Disagree***	***Strongly Disagree***	***Don't Know***
Agriculture (n=344)	28.8% *(n=99)*	36.9% *(n=127)*	10.8% *(n=37)*	5.8% *(n=20)*	9.3% *(n=32)*	8.4% *(n=29)*
Animal Behaviour & Welfare PG (n=107)	57.0% *(n=61)*	30.8% *(n=33)*	2.8% *(n=3)*	1.9% *(n=2)*	3.7% *(n=4)*	3.7% *(n=4)*
Animal Behaviour & Welfare UG (n=136)	33.8% *(n=46)*	33.1% *(n=45)*	8.8% *(n=12)*	8.1% *(n=11)*	6.6% *(n=9)*	9.6% *(n=13)*
Biology (n=266)	33.1% *(n=88)*	45.1% *(n=120)*	6.8% *(n=18)*	5.3% *(n=14)*	3.0% *(n=8)*	6.8% *(n=18)*
Equine (n=94)	35.1% *(n=33)*	40.4% *(n=38)*	5.3% *(n=5)*	5.3% *(n=5)*	7.4% *(n=7)*	6.4% *(n=6)*
Veterinary (n=1376)	62.9% *(n=866)*	32.0% *(n=440)*	1.7% *(n=24)*	1.2% *(n=17)*	0.9% *(n=12)*	1.2% *(n=17)*
Veterinary Nursing (n=151)	49.7% *(n=75)*	27.8% *(n=42)*	7.9% *(n=12)*	2.0% *(n=3)*	6.6% *(n=10)*	6.0% *(n=9)*
Total students (n=2474)	51.3% *(n=1268)*	34.2% *(n=845)*	4.5% *(n=111)*	2.9% *(n=72)*	3.3% *(n=82)*	3.9% *(n=96)*

Some degree of pain is beneficial to farm animals	***Strongly Agree***	***Agree***	***Neither agree nor disagree***	***Disagree***	***Strongly Disagree***	***Don't Know***
Agriculture (n=344)	1.2% *(n=4)*	8.1% *(n=28)*	15.7% *(n=54)*	34.3% *(n=118)*	39.5% *(n=136)*	1.2% *(n=4)*
Animal Behaviour & Welfare PG (n=107)	0.9% *(n=1)*	11.2% *(n=12)*	4.7% *(n=5)*	34.6% *(n=37)*	44.9% *(n=48)*	3.7% *(n=4)*
Animal Behaviour & Welfare UG (n=137)	1.5% *(n=2)*	6.6% *(n=9)*	11.7% *(n=16)*	25.5% *(n=35)*	52.6% *(n=72)*	2.2% *(n=3)*
Biology (n=266)	0.4% *(n=1)*	8.3% *(n=22)*	15.0% *(n=40)*	27.4% *(n=73)*	44.4% *(n=118)*	4.5% *(n=12)*
Equine (n=93)	1.1% *(n=1)*	9.7% *(n=9)*	8.6% *(n=8)*	31.2% *(n=29)*	48.4% *(n=45)*	1.1% *(n=1)*
Veterinary (n=1374)	1.1% *(n=15)*	5.9% *(n=81)*	8.4% *(n=115)*	28.2% *(n=388)*	54.2% *(n=745)*	2.2% *(n=30)*
Veterinary Nursing (n=150)	1.3% *(n=2)*	6.7% *(n=10)*	10.7% *(n=16)*	26.7% *(n=40)*	53.3% *(n=80)*	1.3% *(n=2)*
Total students (n=2471)	1.1% *(n=26)*	6.9% *(n=171)*	10.3% *(n=254)*	29.1% *(n=720)*	50.3% *(n=1244)*	2.3% *(n=56)*

Table 3.13 (*continued*)Percentage (number) of students for each level of agreement for 4 statements about pain

It is difficult to recognise pain in farm animals	***Strongly Agree***	***Agree***	***Neither agree nor disagree***	***Disagree***	***Strongly Disagree***	***Don't Know***
Agriculture (n=344)	2.3% *(n=8)*	25.3% *(n=87)*	14.8% *(n=51)*	41.9% *(n=144)*	14.2% *(n=49)*	1.5% *(n=5)*
Animal Behaviour & Welfare PG (n=107)	3.7% *(n=4)*	31.8% *(n=34)*	7.5% *(n=8)*	38.3% *(n=41)*	15.9% *(n=17)*	2.8% *(n=3)*
Animal Behaviour & Welfare UG (n=137)	5.1% *(n=7)*	28.5% *(n=39)*	15.3% *(n=21)*	32.1% *(n=44)*	15.3% *(n=21)*	3.6% *(n=5)*
Biology (n=266)	1.9% *(n=5)*	27.8% *(n=74)*	15.0% *(n=40)*	36.1% *(n=96)*	13.5% *(n=36)*	5.6% *(n=15)*
Equine (n=94)	2.1% *(n=2)*	23.4% *(n=22)*	18.1% *(n=17)*	38.3% *(n=36)*	13.8% *(n=13)*	4.3% *(n=4)*
Veterinary (n=1376)	4.0% *(n=55)*	40.0% *(n=550)*	14.8% *(n=204)*	33.0% *(n=454)*	7.3% *(n=101)*	0.9% *(n=12)*
Veterinary Nursing (n=149)	2.0% *(n=3)*	34.9% *(n=52)*	14.8% *(n=22)*	32.9% *(n=49)*	8.7% *(n=13)*	6.7% *(n=10)*
Total students (n=2473)	3.4% *(n=84)*	34.7% *(n=858)*	14.7% *(n=363)*	34.9% *(n=864)*	10.1% *(n=250)*	2.2% *(n=54)*

Pain relieving drugs are not necessary for farm animals	***Strongly Agree***	***Agree***	***Neither agree nor disagree***	***Disagree***	***Strongly Disagree***	***Don't Know***
Agriculture (n=344)	2.0% *(n=7)*	4.4% *(n=15)*	10.2% *(n=35)*	44.5% *(n=153)*	37.2% *(n=128)*	1.7% *(n=6)*
Animal Behaviour & Welfare PG (n=107)	0.0% *(n=0)*	0.0% *(n=0)*	2.8% *(n=3)*	28.0% *(n=30)*	67.3% *(n=72)*	1.9% *(n=2)*
Animal Behaviour & Welfare UG (n=137)	0.0% *(n=0)*	2.9% *(n=4)*	5.8% *(n=8)*	30.7% *(n=42)*	58.4% *(n=80)*	2.2% *(n=3)*
Biology (n=266)	0.0% *(n=0)*	2.3% *(n=6)*	10.9% *(n=29)*	41.7% *(n=111)*	41.4% *(n=110)*	3.8% *(n=10)*
Equine (n=93)	2.2% *(n=2)*	4.3% *(n=4)*	7.5% *(n=7)*	26.9% *(n=25)*	58.1% *(n=54)*	1.1% *(n=1)*
Veterinary (n=1376)	0.4% *(n=5)*	0.9% *(n=12)*	3.4% *(n=47)*	28.0% *(n=385)*	67.2% *(n=924)*	0.2% *(n=3)*
Veterinary Nursing (n=150)	1.3% *(n=2)*	2.0% *(n=3)*	1.3% *(n=2)*	24.0% *(n=36)*	70.0% *(n=105)*	1.3% *(n=2)*
Total students (n=2473)	0.6% *(n=16)*	1.8% *(n=44)*	5.3% *(n=131)*	31.6% *(n=782)*	59.6% *(n=1473)*	1.1% *(n=27)*

Table 3.14 Factor loadings and means scores (standard deviation) of each item on the 'attitudes to pain and analgesic use' and 'belief in animal mind' scale, and eigenvalues and Cronbach's alpha (α) internal reliability of the scales

	Loading	Mean (±SD)		Eigenvalue	α
Attitudes to pain and analgesic use				1.52	0.47
Some degree of pain is beneficial to the animal	0.70	4.24	(0.98)		
Farm animals benefit from pain alleviation (reverse coded)	0.60	4.33	(0.95)		
Pain relieving drugs are not necessary for farm animals	0.77	4.51	(0.73)		

Table 3.15 Effects of age, course and gender on students' 'Attitudes to Pain in Livestock' scores

	wald	f	df	*p*
Attitudes to pain in livestock				
Age group	81.99	27.33	2038.0	<0.001
Course	115.18	19.20	2038.0	<0.001
Gender	48.13	48.13	2038.0	<0.001

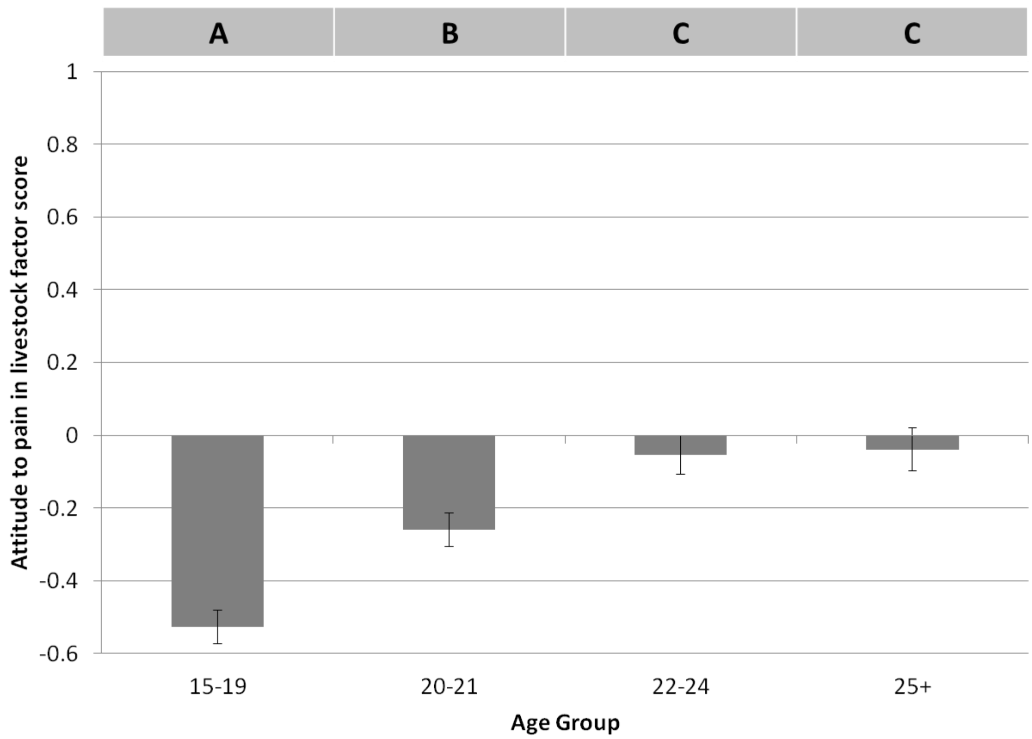

Figure 3.11 Mean (s.e.) attitudes to pain in livestock scores for each age group

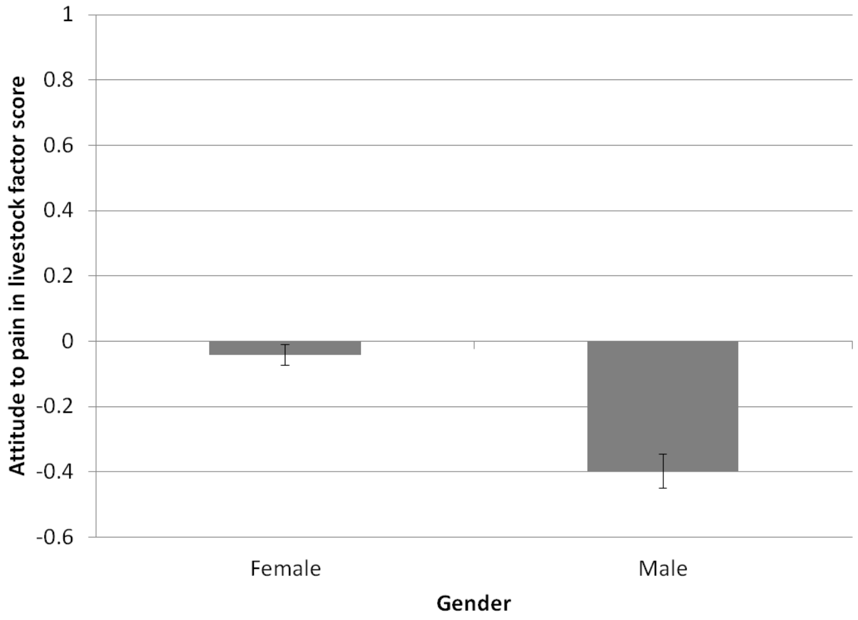

Figure 3.12 Mean (s.e.) attitudes to pain in livestock scores for males and females.

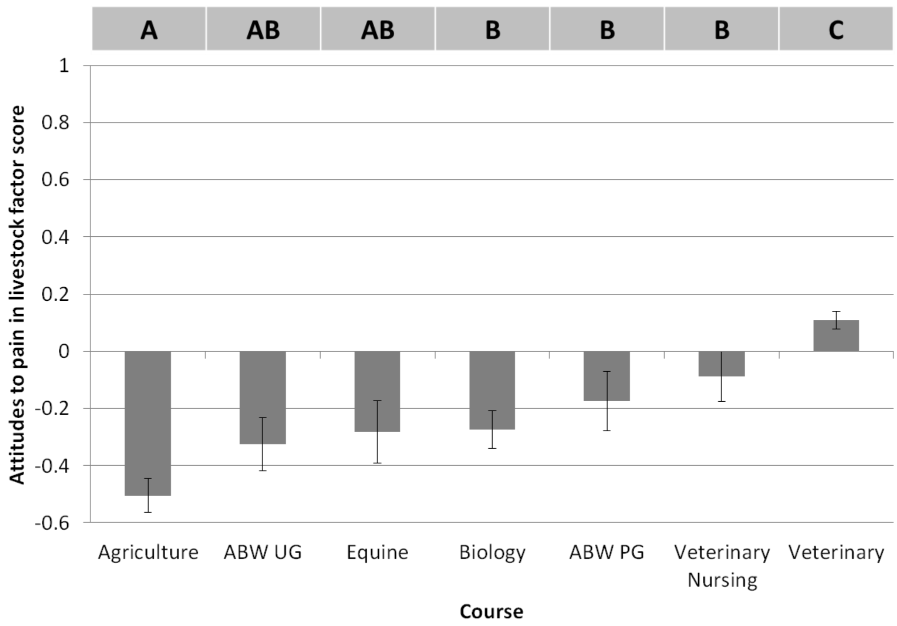

Figure 3.13 Mean (s.e.) attitudes to pain in livestock scores for each course. Courses that do not share a letter are statistically different from each other at $p<0.01$.

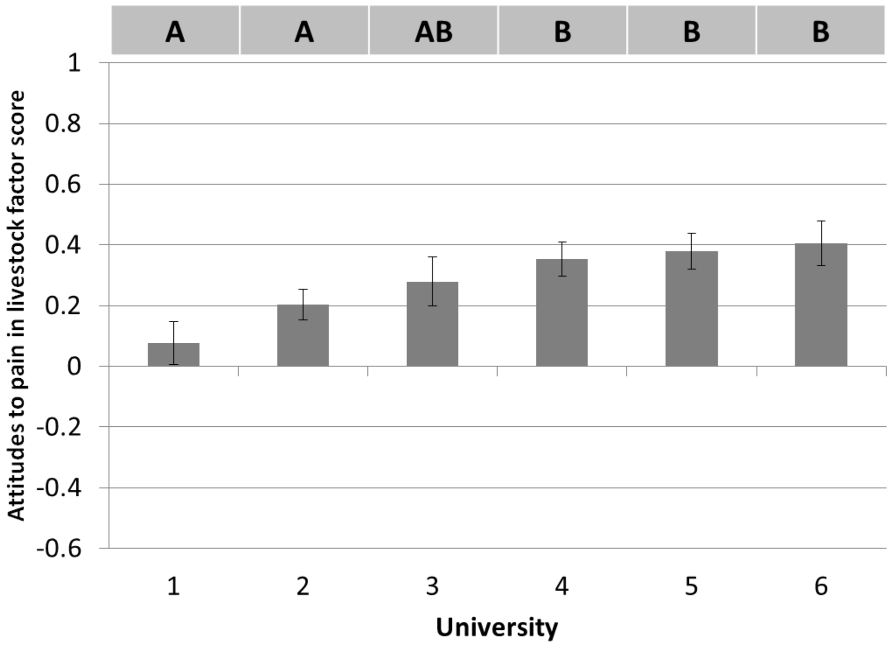

Figure 3.14 Mean (s.e.) attitudes to pain in livestock scores for veterinary students from each university. Universities that do not share a letter are statistically different from each other at p<0.05.

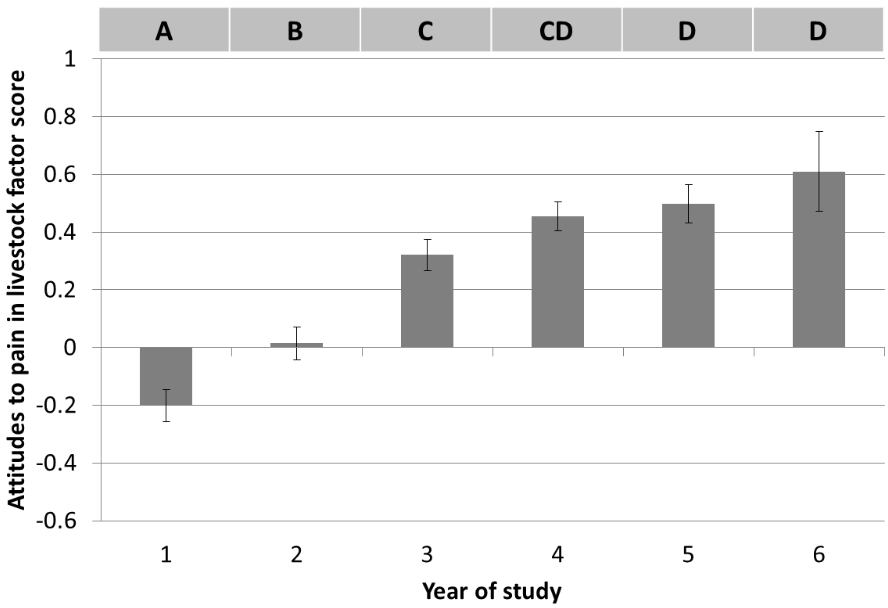

Figure 3.15 Mean (s.e.) attitudes to pain in livestock scores for veterinary students across six years of study. Years that do not share a letter are statistically different from each other at p<0.05

Table 3.16 Effect of university and year of study on 'Attitudes to Pain in Livestock' scores of agriculture, veterinary and veterinary nursing students

		Wald	f	df	*p*
University	*Agriculture*	9.40	1.57	217.0	0.158
	Veterinary	19.59	3.92	1119.0	0.002
	Veterinary nursing	4.99	1.66	102.0	0.100
Year	*Agriculture*	9.83	1.64	217.0	0.138
	Veterinary	126.96	25.39	1119.0	<0.001
	Veterinary nursing	1.62	0.54	102.0	0.656

4.5 Belief in animal mind

Overall students believe that animals have minds, with 70 and 80% answering yes to '*most animals are able to think to some extent to solve problems and make decisions about what to do'* and *'most animals are capable of experiencing a range of feelings and emotions'* respectively (Table 3.17). In addition 60 and 74% of students answered no to '*most animals are unaware of what they are doing, mechanically responding to instinctive urges without awareness'* and *'most animals are unaware of what is happening to them'* respectively.

The Kaiser-Meyer-Olkin measure of sampling adequacy (0.642) indicated that the BAM statements had adequate commonalities to warrant component analysis. Bartlett's test of sphericity showed that there were adequate correlations (Chi-Sq: 1280; df: 6, $p<0.001$) between the variables to allow for component reduction. The Cronbach's alpha internal reliability was 0.637 which is considered adequate for a novel psychological scale (Table 3.19).

Table 3.17 Percentage (number) of students for each level of agreement for 4 'Belief in Animal Mind' statements

	Percentage *(number)*					
Most animals are unaware of what is happening to them	***Yes definitely***	***Yes, probably***	***Possibly to a limited extent***	***No, probably not***	***No, definitely not***	***Don't Know***
Agriculture (n=333)	3.3 *(n=11)*	9.9% *(n=33)*	21.0% *(n=70)*	32.7% *(n=109)*	33.0% *(n=110)*	0.0% *(n=0)*
Animal Behaviour & Welfare PG (n=106)	0.9% *(n=1)*	0.9% *(n=1)*	9.4% *(n=10)*	23.6% *(n=25)*	64.2% *(n=68)*	0.9% *(n=1)*
Animal Behaviour & Welfare UG (n=129)	3.9% *(n=5)*	5.4% *(n=7)*	10.9% *(n=14)*	33.3% *(n=43)*	46.5% *(n=60)*	0.0% *(n=0)*
Biology (n=264)	1.9% *(n=5)*	8.3% *(n=22)*	16.7% *(n=44)*	31.1% *(n=82)*	41.3% *(n=109)*	0.8% *(n=2)*
Equine (n=92)	2.2% *(n=2)*	6.5% *(n=6)*	16.3% *(n=15)*	30.4% *(n=28)*	44.6% *(n=41)*	0.0% *(n=0)*
Veterinary (n=1353)	0.5% *(n=7)*	4.7% *(n=64)*	14.3% *(n=193)*	31.9% *(n=432)*	48.1% *(n=651)*	0.4% *(n=6)*
Veterinary Nursing (n=150)	0.0% *(n=0)*	10.0% *(n=15)*	18.0% *(n=27)*	17.3% *(n=26)*	54.0% *(n=81)*	0.7% *(n=1)*
Total students (n=2427)	1.3% *(n=31)*	6.1% *(n=148)*	15.4% *(n=373)*	30.7% *(n=745)*	46.1% *(n=1120)*	0.4% *(n=10)*

	Percentage *(number)*					
Most animals are capable of experiencing a range of feelings and emotions	***Strongly Agree***	***Agree***	***Neither agree nor disagree***	***Disagree***	***Strongly Disagree***	***Don't Know***
Agriculture (n=334)	40.1% *(n=134)*	35.9% *(n=120)*	18.3% *(n=61)*	3.9% *(n=13)*	0.9% *(n=3)*	0.9% *(n=3)*
Animal Behaviour & Welfare PG (n=106)	63.2% *(n=67)*	28.3% *(n=30)*	7.5% *(n=8)*	0.9% *(n=1)*	0.0% *(n=0)*	0.0% *(n=0)*
Animal Behaviour & Welfare UG (n=131)	51.9% *(n=68)*	36.6% *(n=48)*	9.2% *(n=12)*	1.5% *(n=2)*	0.0% *(n=0)*	0.8% *(n=1)*
Biology (n=264)	44.7% *(n=118)*	36.7% *(n=97)*	16.3% *(n=43)*	1.1% *(n=3)*	0.4% *(n=1)*	0.8% *(n=2)*
Equine (n=92)	64.1% *(n=59)*	27.2% *(n=25)*	5.4% *(n=5)*	1.1% *(n=1)*	2.2% *(n=2)*	0.0% *(n=0)*
Veterinary (n=1355)	42.0% *(n=569)*	41.7% *(n=565)*	13.4% *(n=182)*	2.1% *(n=28)*	0.3% *(n=4)*	0.5% *(n=7)*
Veterinary Nursing (n=150)	60.0% *(n=90)*	26.7% *(n=40)*	11.3% *(n=17)*	1.3% *(n=2)*	0.7% *(n=1)*	0.0% *(n=0)*
Total students (n=2432)	45.4% *(n=1105)*	38.0% *(n=925)*	13.5% *(n=328)*	2.1% *(n=50)*	0.5% *(n=11)*	0.5% *(n=13)*

Table 3.18 (*continued*) Percentage (number) of students for each level of agreement for 4 'Belief in Animal Mind' statements

	Percentage *(number)*					
Most animals are unaware of what they are doing, mechanically responding to instinctive urges without awareness	***Strongly Agree***	***Agree***	***Neither agree nor disagree***	***Disagree***	***Strongly Disagree***	***Don't Know***
Agriculture (n=334)	3.3% *(n=11)*	14.7% *(n=49)*	28.1% *(n=94)*	29.0% *(n=97)*	22.5% *(n=75)*	2.4% *(n=8)*
Animal Behaviour & Welfare PG (n=106)	0.0% *(n=0)*	2.8% *(n=3)*	13.2% *(n=14)*	35.8% *(n=38)*	48.1% *(n=51)*	0.0% *(n=0)*
Animal Behaviour & Welfare UG (n=130)	3.1% *(n=4)*	10.9% *(n=14)*	21.7% *(n=28)*	31.8% *(n=41)*	29.5% *(n=38)*	3.1% *(n=4)*
Biology (n=265)	1.9% *(n=5)*	10.6% *(n=28)*	26.4% *(n=70)*	32.8% *(n=87)*	26.8% *(n=71)*	1.5% *(n=4)*
Equine (n=92)	4.3% *(n=4)*	18.5% *(n=17)*	25.0% *(n=23)*	26.1% *(n=24)*	23.9% *(n=22)*	2.2% *(n=2)*
Veterinary (n=1354)	0.5% *(n=7)*	8.9% *(n=121)*	24.1% *(n=327)*	37.5% *(n=508)*	28.0% *(n=379)*	1.0% *(n=13)*
Veterinary Nursing (n=150)	0.7% *(n=1)*	12.0% *(n=18)*	24.7% *(n=37)*	31.3% *(n=47)*	29.3% *(n=44)*	2.0% *(n=3)*
Total students (n=2431)	1.3% *(n=32)*	10.3% *(n=250)*	24.4% *(n=593)*	34.6% *(n=842)*	28.0% *(n=680)*	1.4% *(n=34)*

	Percentage *(number)*					
Most animals are able to think to some extent to solve problems and make decisions about what to do	***Strongly Agree***	***Agree***	***Neither agree nor disagree***	***Disagree***	***Strongly Disagree***	***Don't Know***
Agriculture (n=334)	26.9% *(n=90)*	38.9% *(n=130)*	24.6% *(n=82)*	6.6% *(n=22)*	2.1% *(n=7)*	0.9% *(n=3)*
Animal Behaviour & Welfare PG (n=106)	48.1% *(n=51)*	40.6% *(n=43)*	9.4% *(n=10)*	1.9% *(n=2)*	0.0% *(n=0)*	0.0% *(n=0)*
Animal Behaviour & Welfare UG (n=129)	40.0% *(n=52)*	36.2% *(n=47)*	18.5% *(n=24)*	2.3% *(n=3)*	2.3% *(n=3)*	0.8% *(n=1)*
Biology (n=265)	38.5% *(n=102)*	38.5% *(n=102)*	17.4% *(n=46)*	4.9% *(n=13)*	0.4% *(n=1)*	0.4% *(n=1)*
Equine (n=92)	38.0% *(n=35)*	41.3% *(n=38)*	14.1% *(n=13)*	4.3% *(n=4)*	2.2% *(n=2)*	0.0% *(n=0)*
Veterinary (n=1355)	31.5% *(n=427)*	39.7% *(n=538)*	23.9% *(n=324)*	3.7% *(n=50)*	0.9% *(n=12)*	0.2% *(n=3)*
Veterinary Nursing (n=150)	45.3% *(n=68)*	28.0% *(n=42)*	20.7% *(n=31)*	2.0% *(n=3)*	2.0% *(n=3)*	2.0% *(n=3)*
Total students (n=2431)	33.9% *(n=825)*	38.7% *(n=940)*	21.8% *(n=530)*	4.0% *(n=97)*	1.2% *(n=28)*	0.5% *(n=11)*

Table 3.19 Factor loadings and means scores (standard deviation) of each item on the 'attitudes to pain and analgesic use' and 'Belief in Animal Mind' scale, and eigenvalues and Cronbach's alpha (α) internal reliability of the scales

	Loading	Mean (±SD)		Eigenvalue	α
Belief in animal mind				1.92	0.64
Most animals are capable of experiencing a range of feelings and emotions	0.63	4.27	(0.80)		
Most animals are able to think to some extent to solve problems and make decisions about what to do	0.70	4.01	(0.91)		
Most animals are unaware of what is happening to them (reverse coded)	0.68	4.15	(0.98)		
Most animals are unaware of what they are doing, mechanically responding to instinctive urges without awareness (reverse coded)	0.74	3.79	(1.01)		

Significant main effects of age, gender and course were found on students' BAM scores (Table 3.20). Older students (Figure 3.16) and females (Figure 3.17) had higher BAM scores. Agriculture students had the lowest and ABW post grads the highest BAM scores (Figure 3.18). No difference in BAM was found between academic institutions or for year of study for agriculture or veterinary nursing students (Table 3.22) however a significant difference was found between year of study for vet students with BAM scores being higher in the students in later years (Figure 3.19). Significant positive correlations were found between ALP and BAM scores (**Error! Reference source not found.**).

Table 3.20 Effects of age, course and gender on 'Belief in Animal Mind' scores

	wald	f	df	*p*
Belief in animal mind				
Age group	55.38	18.46	2092.0	<0.001
Course	32.35	5.39	2092.0	<0.001
Gender	26.52	26.52	2092.0	<0.001

Table 3.21 Spearman Rank Correlation (*r*) between students' attitudes to pain in livestock and their belief in animal mind

	r	*p*
All students	0.249	<0.001
Agriculture	0.255	<0.001
ABW PG	0.349	<0.001
ABW UG	0.339	<0.001
Biology	0.372	<0.001
Equine	0.227	0.040
Veterinary	0.203	<0.001
Veterinary nursing	0.154	0.079

Table 3.22 Effect of university and year of study on 'Belief in Animal Mind' scores of agriculture, veterinary and veterinary nursing students

		wald	f	df	*p*
Belief in animal mind					
University	*Agriculture*	5.59	0.93	222.0	0.473
	Veterinary	0.99	0.20	112.0	0.963
	Veterinary nursing	3.87	1.29	107.0	0.282
Year	*Agriculture*	4.50	1.50	222.0	0.216
	Veterinary	42.45	8.49	112.0	<0.001
	Veterinary nursing	3.94	1.31	107.0	0.274

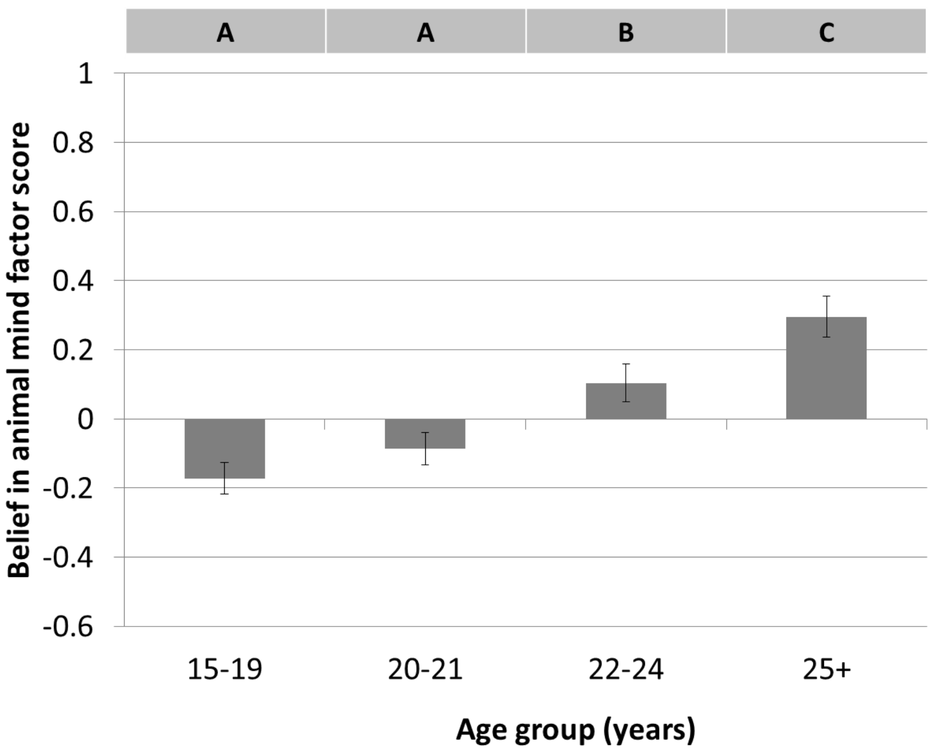

Figure 3.16 Mean (s.e.) 'Belief in Animal Mind' scores for each age group. Age groups that do not share a letter are statistically different from each other at p<0.01.

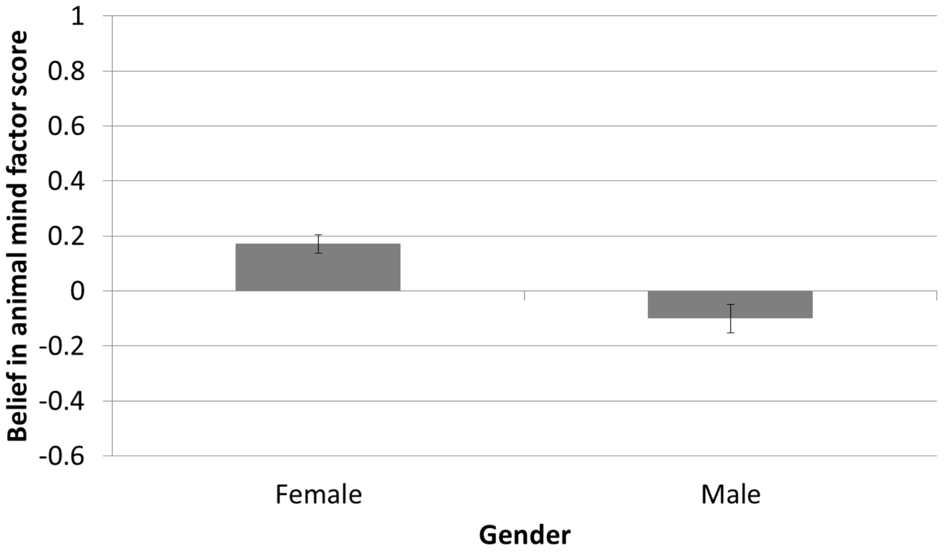

Figure 3.17 Mean (s.e.) 'Belief in Animal Mind' scores for females and males.

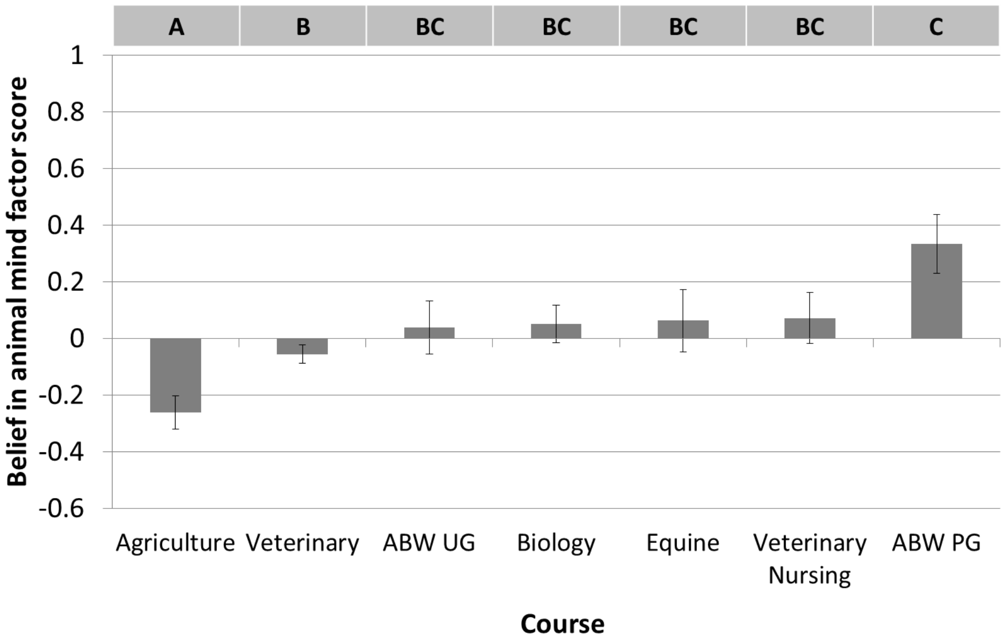

Figure 3.18 Mean (s.e.) 'Belief in Animal Mind' scores for each course.

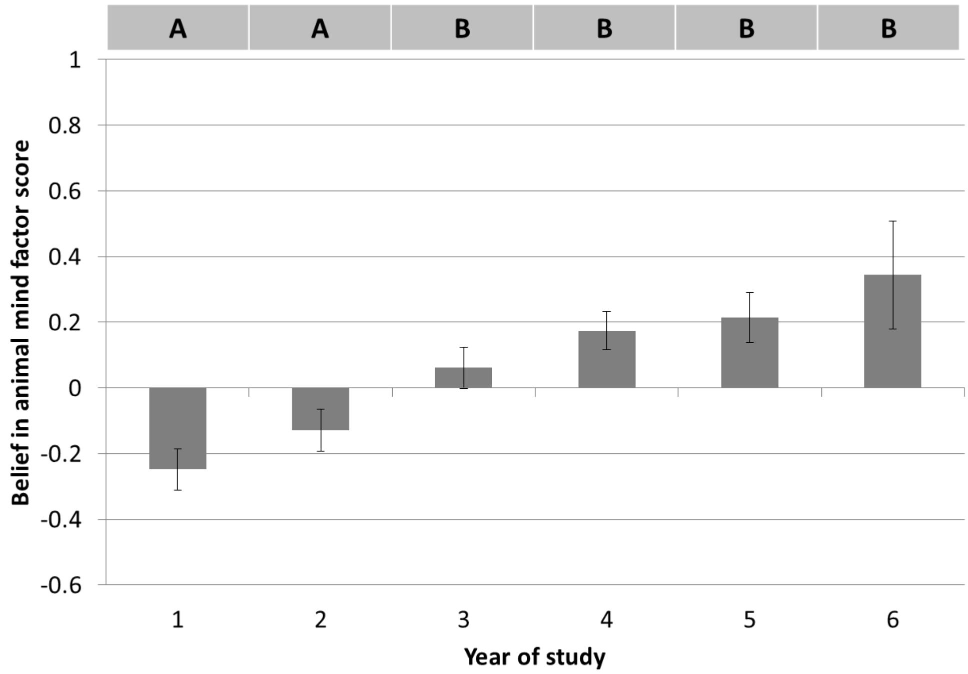

Figure 3.19 Mean (s.e.) ‘Belief in Animal Mind’ scores for veterinary students across six years of study. Years that do not share a letter are statistically different from each other at $p<0.05$.

5. Discussion

The aim of this study was to assess the attitudes of students studying animal related subjects towards animal welfare and sentience. These students are the next generation of farmers, veterinarians, veterinary nurses, and animal scientists and, as such, their attitudes towards animals will likely impact upon how they treat the animals in their care. To our knowledge this is the largest questionnaire that has been conducted on students' attitudes to animal welfare, with over 2,500 students from seventeen academic institutions across the UK and Ireland participating. Completed questionnaires were received from over 1,400 veterinary medicine students from six of the seven vet schools within the UK. In addition, almost 350 students studying agricultural science from six of the UK's top agricultural institutions took part. Therefore this questionnaire provides a snapshot of the attitudes held by the current cohort of students who will be the next generation of animal carers. In addition to being able to efficiently recruit large numbers of participants, online questionnaires also allow for the order of questions to be randomised for each participant. Randomised ordering of questions within each section was used here to prevent the possibility that order would influence how participants answered the questions.

5. 1 Freedoms

On average, students considered each of the welfare needs to be important, as indicated by average scores of over 65 out of 100 for all statements. However, significant differences were found, with ‘prompt treatment' receiving the highest scores and ‘hunger’ the lowest. To our knowledge no other study has investigated the attitudes of students studying animal related subjects to farm animal welfare using the Five Freedoms welfare framework. However a study of British adolescents (14-15 year olds) were asked about their attitudes to ‘pain and suffering’ and ‘behavioural freedom’ in livestock using 14 attitude statements (Abeyesinghe et al., 2013). Participants had a statistically higher level of agreement with the statements pertaining to ‘pain and suffering’ than those pertaining to ‘behavioural freedom’ indicating that pain was perceived to impact more negatively on animal welfare than restricted behaviour freedom. This is similar to the results found here, with students rating ‘pain relief’ and ‘prompt treatment’ significantly higher than ‘normal behaviour'. This perceived difference between the importance of freedom from pain and behavioural freedom was also found in two studies investigating attitudes of US animal science (Heleski et al., 2004) and veterinary college (Heleski et al., 2005) faculty members to farm animal welfare. These studies assessed participants’ levels of agreement to a number of statements based on the Five Freedoms. Behavioural freedom received the lowest scores and statements pertaining to pain and disease were rated significantly higher, within the top four. In contrast to our findings - where hunger was scored lowest in these two studies - hunger was rated within the top four, receiving similar scores to the statements pertaining to freedom from pain and disease. These two studies also included freedom from thirst, which received the highest scores above those for pain and disease. In addition, the authors also conducted a study that looked at US animal science students' views on animal welfare (Heleski, 2004; Heleski et al., 2005). In a scenario where the basic needs of livestock were met (food, bedding, water and basic health care) students were asked what were the additional needs of animals to ensure good welfare. Students were asked how important they felt eight welfare requirements were. Forty-three percent of students said that being '*free from distressing handling situations*' was very important, 60% said it was very important that animals '*can engage in … natural behaviours*' and 65% said it was very important that animals are '*free from painful procedures without anaesthetic*'. In comparison more people felt that space (72%), '*freedom from predators*' (79%) and a '*humane death*' (85%) were very important.

A significant effect of age was found on how the freedoms were scored, with 15-21 year olds giving lower scores than those aged 22 or over. Although not directly comparable, a study of agriculture students found that older students scored higher on a component pertaining to animal welfare than younger students (Austin et al., 2005). This result could reflect the change in views and knowledge that occur over a student's academic career, both as a result of education but also from being exposed to a diverse array of perspectives from people with backgrounds different to their own.

5.2 Capacity to feel Pain

Students perceive there to be a difference between animal species in their capacity to feel pain, with variation occurring between course, gender and age group. Fish were consistently rated as having a significantly lower pain capacity than the other seven species regardless of course, gender or age. Although humans were consistently scored as having the highest pain capacity, agricultural and vet students were the only groups to score humans significantly higher than all the other species. ABW, equine, biology and vet nursing students assigned similar scores for humans, horses and dogs. All student groups assigned similar scores for dogs and horses with the exception of agriculture students who rated dogs higher. The pain capacity scores suggest an overall grouping of species, with the three mammalian livestock species: sheep, cattle and pigs, being seen as having a similar pain capacity. As the two companion animal species, dogs and horses are also scored similarly. Only three groups scored chickens as having similar pain capacities to other species; vet nurses scored chickens similarly to sheep, ABW students scored chickens similarly to sheep and pigs, and post graduates gave chickens similar scores to cattle. Agriculture students viewed sheep, cattle, pigs and horses as having a very similar capacity to feel pain, with no overlap with other species as is seen for all the other student groups. Perhaps surprisingly veterinary students rated the pain capacity of pigs significantly higher than that of sheep and cattle, and similar to horses. Other groups also perceived pigs to have a high pain capacity with ABW PG, biology and vet nursing students all assigning similar scores for pigs and humans. This perception that pigs are more capable of experiencing pain may come from their reputation as being highly intelligent animals (Mendl et al., 2010), however cognition and pain capacity are not necessarily related and using human assessed cognitive abilities of an animal as a way of assigning sentience capacity is likely to have implications for pain management. Vet students perceive pigs as having a higher capacity for pain than other livestock species; it is therefore possible that analgesic and anaesthetics use in pigs is higher as a result. A study of perceptions of animal sentience asked biology students to rate a number of animal species on how alike they were to humans in their capacity to experience pain, happiness, fear, or boredom (Phillips and McCulloch, 2005). These four scores were combined to create a total perceived sentience score. Monkeys, dogs and new born babies were attributed with 80, 79, and 77% of human sentience while foxes, pigs and chickens were attributed with 67, 65, and 59% of human sentience. These results demonstrate differences with regard to how these students perceived the sentience levels of these species. Not surprisingly monkeys and human babies were rated as most similar to humans. Perhaps of interest is the high sentience scores attributed to dogs, especially in comparison to the lower rating of foxes. The authors suggest that the high rating of dogs may be attributable to peoples' familiarity with emotions shown by dogs that appear to be similar to those of humans. Ratings of sentience for pigs and chickens by British students were significantly correlated with attitude statements about the use of crates and battery cages, with those who disagreed with their use rating sentience higher. Chickens were attributed with

59% of human sentience; this is similar to the difference seen here in how the capacity of chickens and humans to feel pain was scored, with respective means of 59 and 80 out of 100. A study of US animal science students (Heleski, 2004) asked students to rate on a scale from 1 to 4 how similar five species of livestock were to humans in how they experience pain. Mean scores for all five species, (horses, pigs, cattle, sheep and poultry) were between 1 and 2 with a score of 1 representing the response '*yes, in a way very similar to people*' and 2 being ' *yes, though not as intensely as people*'. This supports the results found in this study where students assigned similar but not the same scores for humans, pigs, cattle, sheep and poultry.

Overall these results suggest a perceived hierarchy, with fish and poultry being seen as having a lower pain capacity than mammals. Within the six mammals species the results are more difficult to pick apart but do suggest that a perceived difference between livestock and companion animal species may exist. These results support findings from previous studies that suggest a level of speciesism exists in terms of how people view the mental and emotional capabilities of different species. A study of US vet students found that although 90% of students believed that cats and dogs had the capacity to feel emotions, less than 80% believed that cows, pigs, sheep and goats did, and less than 50% of the students believed poultry did (Levine et al., 2005). A study of European and Asian students found a similar pattern in the level of sentience attributed by British students to a number of species (Izmirli et al., 2012), with fish and chickens being rated lower than pigs, cattle and horses, and with pigs and horses and horses and dogs being rated similarly. This bias to attribute capabilities to other species may be based on how the similarity of those species to humans is perceived which would explain the close proximity of the mammal species' and the distance of the avian and fish species. This phenomenon has been discussed in relation to the phylogenetic tree, with humans being more comfortable assigning shared capabilities to more similar species (Mendl, 2004). Another reason for these results could be familiarity; an individual's familiarity with a species may impact upon how that person views the sentience and abilities of that species (Morris et al., 2012). Therefore experience with a species may impact upon the capacities subsequently attributed to that species. This was tested here; the pain capacity scores given by students for each species were compared based on whether a student had experience of working with that species. Students that had experience of working with fish, pigs, dogs and horses assigned higher pain capacity scores for these species in comparison to students who did not have experience working with these species. In contrast, no difference was found between the pain capacity scores given for chickens, sheep, and cattle regardless of whether students had experience of working with these species. A similar finding was reported whereby people who owned a horse or a dog assigned a greater emotional capacity to that species than non-owners (Morris et al., 2012).

A significant interaction was found between gender and species in how the capacity of different species to feel pain was scored, with males assigning significantly lower scores than females for all eight species. This is in contrast to the results of a study where no gender differences were found in the level of sentience attributed to eight different animal species including fish, chickens, pigs and dogs (Phillips and McCulloch, 2005). This difference in findings could be due to the fact that Philips and McCulloch used a sentience measure that combined ratings for pain, happiness, fear and boredom, whereas our study was only interested in pain capacity. In addition the study was not targeted towards animal related subjects and students from a variety of subject backgrounds will have taken part. Perhaps more comparable is a study on UK veterinary students' attitudes towards animal welfare (Paul and Podberscek, 2000) where students were asked to rate the ability of four animal species (dogs, cats, pigs and cows) to feel pain in comparison to people. Gender differences were found for the pain ratings of cats and cows with females providing higher ratings than males.

The pain capacity ratings of the eight species follows a similar pattern of how participants rated the intelligence of a number of species: ape, dog, cat, horse, cow, sheep, chicken, fish (Banks and Flora, 1977), suggesting that peoples' perceptions of animal sentience and pain capacity is associated with their perceptions of how intelligent, or more aptly what the cognitive capabilities of an animal is. The importance of cognitive ability - the ability to process information - for pain experience is unclear, as is the difference between the potential suffering experienced by an animal that is self-conscious versus one that has only basic emotions and sensations (Mendl et al., 2010). Therefore the use of 'intelligence' as a guideline for pain capacity is likely to be unhelpful. However a very strong positive correlation was found between peoples' perceptions of the cognitive abilities of different animal species and sentience (Herzog and S, 1997). The authors propose that this is as a result of a phylogenetic effect; something they believe is further evidenced by the significant perceived differences in cognitive abilities and sentience between three animal groups, invertebrates, non-mammalian vertebrates and mammals.

5.3 Attitudes to pain in livestock

Overall students had positive attitudes to pain in livestock with 86% agreeing that *'farm animals benefit from pain alleviation'* and only 2% agreeing that '*pain relieving drugs are not necessary for farm animals*'. To our knowledge no other study has specifically asked students about their views on pain in livestock so it is not possible to make direct comparisons with the literature, however these results are very similar to those found in our study of farmers' attitudes to pain in livestock as detailed in chapter two, with 93% agreeing that *'farm animals benefit from pain alleviation'* and only 8 and 2% of farmers respectively agreeing that '*some degree of pain is beneficial to the animal'* and '*pain relieving drugs are not necessary for farm animals*'. Student views were split over whether *'it is difficult to recognise pain in farm animals'* with 38% agreeing, and 45% disagreeing. This is quite different from the results of our farmer study where only 14% of farmers agreed with this statement. It is in fact more comparable to the respective 33 and 40% of UK pig farmers and vets (Ison and Rutherford, 2014) and the 40% of Finnish cattle vets (Raekallio et al., 2003) that agreed with the same statement.

A study of the attitudes of veterinary nurses and veterinary nursing students to pain in animals found that over 90% of participants agreed that analgesics were beneficial for animals (Coleman and Slingsby, 2007). This is substantially higher than the finding of the current study where 77% of student vet nurses agreed that pain alleviation was beneficial for animals. Agreement from vet students was also higher with 95% agreeing. However 94% of vet nurses and 95% of vet students disagreed that '*pain relieving drugs are not necessary for farm animals'*. This is a similar finding to the 99% of vet nurses and vet nursing students who disagreed that '*surgery does not usually result in sufficient pain to warrant analgesic therapy'* (Coleman and Slingsby, 2007). The significant difference between males and females in their APL scores supports the findings of a number of studies that show that females have more positive attitudes towards animals, are more empathetic and provide higher pain scores (Huxley and Whay, 2006; Laven et al., 2009; Paul and Podberscek, 2000; Raekallio et al., 2003) than do males. Differences in APL scores were also seen between the veterinary universities with universities 1 and 2 having less positive attitudes than 3, 4, 5, and 6. This finding may indicate a difference in subculture between universities, and has been seen in another study where students in two different veterinary universities differed in how they perceived the capacity of cows and pigs to experience the sensation of hunger (Paul and Podberscek, 2000). The authors highlight that overall the students were similar in their attitudes, and suggest that if differences in subcultures were present their effects were specific and not broad-ranging. The same could potentially be said for the findings of this present study were no differences were found between universities in how students scored on the BAM scale. However, if there are subcultures present in different universities that do shape students' attitudes these may pervade into their careers and influence their decision making.

Agriculture students had the lowest and vet students the highest APL scores; 82% of vet students disagreed that '*some degree of pain is beneficial to the animal*' compared to 74% of agriculture students. This difference is not seen when comparing farmers' and vets' responses to the same statement from the studies presented in chapter 2 and 4. In these two studies the percentage of farmers and vets disagreeing with this statement was very similar, between 81 and 89%. In this case there is a large amount of similarity between vets and vet students, but less of a similarity between agriculture students and farmers. Responses to other statements also indicate a more positive attitude on the part of farmers compared to agriculture students, for example 95% of farmers versus 66% of agriculture students agreed that '*farm animals benefit from pain alleviation*'. A study of vet students found that a number of painful husbandry procedures were perceived as more humane for livestock than dogs and cats, and that those who planned to go into large animal practice considered a greater number of these procedures humane (Levine et al., 2005). These findings suggest that those working with, or aspiring to work with, livestock have different views on painful procedures than those aspiring to work with small animals.

5.4 Belief in animal mind

Overall the results indicate that students believe that animals have minds, with 70 and 80% answering yes to '*most animals are able to think to some extent to solve problems and make decisions about what to do'* and *'most animals are capable of experiencing a range of feelings and emotions'* respectively. Sixty and 74% of students answered no to '*most animals are unaware of what they are doing, mechanically responding to instinctive urges without awareness'* and *'most animals are unaware of what is happening to them'* respectively. One hundred percent of animal science students answered yes to the question '*do animals have minds? '*compared to 67% of zoology students (Davis and Cheeke, 1998).

Significant differences between course, age group and gender were found, with females and older students reporting higher BAM scores. These findings support those of Herzog and Galvin (1997) who found that females had higher BAM scores than males, and that of Knight et al. (2004) who found that older participants scored BAM higher. Within course an effect of year of study was found on vet students' belief in animal mind, with higher scores being reported by students in later years of study. This is in contrast to a study that found that vet students in later years of study rated animals as having lower levels of sentience than students in earlier years (Paul and Podberscek, 2000). These contrasting findings may be explained by our improved scientific understanding of the physiology and neurobiology of pain and sentience that has occurred in the 18 years between these two studies.

6. Conclusion

Overall, students had positive attitudes to pain in livestock and a strong belief in animal mind. Agriculture students however, had the lowest APL and BAM scores and did not show any change between years of study. In contrast, vet students had higher APL and BAM scores and also demonstrated increased scores in later years of study. This suggests that there is greater focus on these areas within the veterinary teaching curriculum than the agriculture curriculum, which may have implications for farmer–animal interactions and management practices. In addition the differences between these two student groups may lead to difficulties in communication in future farmer–veterinary interactions.

All of the seven animal species presented were viewed as having the capacity to feel pain; however perceived differences between species were evident, with fish and chickens being perceived as having a lower capacity for pain than the five mammal species. Comparisons between the mammal species also reveal differences, such as agriculture students' perceptions that dogs are capable of experiencing pain to a greater extent than sheep, cattle, pigs and horses. Veterinary students made even greater distinctions between these species, viewing the pain capacity of cattle and sheep as significantly lower than that of pigs and horses. This finding is of potential concern when viewed in relation to anaesthetic or analgesic provision. Previous studies have found that the perception of veterinarians to the pain experienced by an animal will influence their decision to use pain medication (Susan E Dohoo and Dohoo, 1996; Hewson et al., 2007b; Huxley and Whay, 2006). It is therefore likely that the view of veterinarians on the capacity an animal has to experience pain will also factor into that decision, raising concerns for the welfare of animals that are perceived as having a lesser capacity to experience pain.

Chapter 4 Attitudes and empathy towards lameness and pain in sheep: implications for treatment

Abstract

Two studies were conducted; the first assessed participants' perceptions of lameness and pain in sheep, the second assessed the relationship between animal orientated empathy, pain perception and the potential impact upon lameness treatment decisions.

Study one assessed the ability of farmers, veterinarians, and students (agriculture and veterinary), to recognise lameness in sheep. Perceptions about pain associated with lameness, and emotional responses to viewing lame sheep were also assessed. In addition the relationship between participants' perceptions and emotional reactions concerning lameness and pain, and their reported willingness to act was investigated. Film recordings of four ewes with varying levels of lameness were shown to participants. After each clip, participants were asked to rate (using a 100mm visual analogue scale (VAS)) the level of: i) lameness (L), ii) pain (P) they felt the sheep was experiencing, and iii) their own emotional response (ER). Strong, positive correlations were found between lameness rating, pain rating and the level of emotional reaction for all three participant groups. Significant interactions between ewe and participant group were found, showing variation between groups in lameness, pain, and emotional reaction scores for each of the different ewes. Vets and vets students were more likely to rate lameness, pain and their own emotional response (LPER) higher; farmers and vets gave similar LPER scores for the 'sound' and 'mildly lame' ewes but vets gave

significantly higher scores ($p<0.05$) for the two 'moderate/severely lame' ewes. A significant relationship was found between participants' decision to catch and inspect the mildly lame ewe and LPER ratings. Those who answered 'yes' to the question '*would you catch this sheep to check its feet'* rated LPER higher than those who answered 'maybe' or 'no'.

Study two further investigated this relationship between human emotion and pain recognition and whether this impacted upon lameness treatment decisions. British farmers and vets watched a video clip of a moderate/severely lame ewe and, using a 100mm VAS, rated the level of pain they perceived her to be in. They then answered a questionnaire on lameness management, and their attitudes to lameness. Factor analysis of the attitude statements revealed four distinct components: i) benefits of analgesic use, ii) affective empathy, iii) judgement of others and iv) compassion. Farmers were more compassionate than vets ($p=0.01$); females were more compassionate ($p=0.002$) and less judgemental of others than males ($p=0.001$) and veterinarians were in stronger agreement with the benefits of analgesic use than farmers ($p<0.001$). Participants who said they would provide pain relief for the observed lame sheep scored more positively on the 'benefits' factor score ($p=0.004$), and participants who said they would treat it with injectable antibiotics rated pain more highly ($p<0.001$). The results demonstrate differences between farmers and vets in the more emotive side of disease and pain management, which may have important implications for decision making surrounding treatment, and possible consequences for the health and welfare of lame sheep.

1. Introduction

Original farmer estimates of lameness in sheep put the UK prevalence at around 8-10% (Grogono-Thomas and Johnston, 1997; Kaler and Green, 2008b; Wassink et al., 2004, 2003). These estimates covered a ten year period and suggest that the prevalence of lameness remains unchanged over this period. In 2011 the Farm Animal Welfare Council (FAWC) set a target to reduce the national prevalence to 5% by 2016 and to 2% by 2021 (FAWC, 2011a). A recently published study of English sheep farms now suggests that lameness prevalence has in fact declined to 5% (Winter et al., 2015), and the results suggest that lowered prevalence is associated with: prompt treatment of the first lame sheep, and whole flock vaccination.

It has been demonstrated that farmers are able to identify mildly lame sheep, but that the subsequent catching and treatment of these animals does not always occur (Kaler and Green, 2008a). The decision to catch was dependent upon the severity of the lameness and the number of lame sheep in the flock, with those who said they would catch the first lame sheep in the flock being significantly more likely to catch a mildly lame sheep. The farmers with higher lameness prevalence (11-15%) were less likely to catch an individual sheep, or would only do so for a more severely lame sheep. Therefore the decision to not catch a lame sheep is likely to increase the lameness prevalence in a flock, due to the highly contagious nature of footrot and contagious ovine digital dermatitis (CODD), or scald (Kaler and Green, 2008a) which account for over 90% of lameness cases in the UK (Kaler and Green, 2008b). The authors propose that the differences seen between farmers in their decision to catch may be influenced by their handling facilities, the availability of time and labour and farmers' perceptions of the associated pain. Farmers who recognise that lameness is likely to result in pain for the affected animal may be more likely to take action to catch and treat lameness.

Within the literature there is much discussion about the relationship between pain perception, pain management and empathy (the ability to recognise and share in the affective state of another). Some studies have in fact used pain ratings as a measure of an individual's level of empathy (Kielland et al., 2010). If the empathy level of a doctor or nurse affects the level of pain management a patient receives then understanding that relationship and ensuring that carers have appropriate levels of empathy is essential to ensuring good patient care (Craig and Buysse, 2009) especially if, as research suggests, empathy levels can decline over time (Newton et al., 2008; Nunes et al., 2011). There is evidence to suggest that empathy plays a part in attitudes to animals; with less empathetic individuals being more in favour of animal experimentation (Broida et al., 1993; Furnham et al., 2003), and more likely to rate pain lower (Ellingsen et al., 2010; Kielland et al., 2010; Norring et al., 2014b). The evolutionary importance of being able to identify pain in others is clear as it enables the observer to subsequently avoid the pain stimulus and/or to assist the individual in pain (Saarela et al., 2007;

Williams, 2002). Empathy for animals may have evolved alongside our domestication of animals as a means with which to understand the needs of animals and develop a form of reciprocal altruism (Leak and Christopher, 1982).

From a psychology perspective, the attitudes of caretakers towards lameness and pain, their perceptions of the severity of pain and their empathetic response to a lame sheep may play important roles in their treatment decisions. In addition, behaviour models such as the theory of planned behaviour highlight the importance of extrinsic elements such as social and cultural beliefs combined with intrinsic elements like social norms and belief in one's own ability (self-efficacy) in predicting behaviour (Ajzen, 1991). Therefore this study aimed to investigate the relationship between self-efficacy, perceptions of social norms and the use of analgesia in lameness management.

Since evidence suggests that more empathetic individuals perceive another's pain as more severe and a high level of empathy causes more positive animal related behaviours understanding how farmers, vets and students perceive the pain associated with lameness and their own emotional reaction may be important in their decision to catch a lame ewe.

The perceptions of students studying animal related subjects (animal behaviour and welfare, agriculture, and veterinary medicine) were investigated, as they will be the animal carers, animal scientists, farmers and vets of the future. The purpose of this current research was to ascertain whether participants perceived lameness to be a painful condition and whether they had an emotional reaction to this. In order to investigate in more detail the role of empathy in lameness management a second study was designed to investigate whether there was a relationship between participants' empathy towards sheep and their lameness management practices. This chapter therefore details the methods and results of two separate but related studies. The methods, results and discussion of each study will be presented separately, followed by a joint discussion that covers both studies.

Study One

Aims & Research questions:

To assess the relationship between observers' assessment of lameness and pain in sheep and their own emotional reaction to these factors, and investigate the relationship between lameness and pain ratings and the decision to catch a sheep to examine its feet.

1. Can farmers, veterinarians and students (agriculture and veterinary) recognise different lameness severities in sheep?
2. Is there a relationship between farmers', veterinarians' and students' (agriculture and veterinary) ratings of lameness or pain and their own emotional response?
3. Is there a difference between farmers, veterinarians and students (agriculture and veterinary) in how they rate lameness and pain, and their own emotional responses?
4. Is there a relationship between farmers', veterinarians' and students' (agriculture and veterinary) lameness, pain and emotional reaction ratings and their decision to catch a lame sheep to examine its feet?
5. Is there a difference between farmers, veterinarians and students (agriculture and veterinary) in their decision to catch a lame sheep to examine its feet?
6. Does gender or age affect how students (agriculture and veterinary) rated lameness and pain, and their own emotional reaction

2. Methodology

2.1 Overview

This study consisted of farmers, veterinarians, and students (animal behaviour and welfare, agriculture, and veterinary medicine) watching video clips of sheep, and completing a short questionnaire for each clip they watched. A total of 283 participants were recruited between June 2013 and March 2014. The study was piloted in June 2013 at the 'North Sheep' event in Yorkshire.

2.2 Videos

Video recordings were made of a number of sheep. Four sheep were subsequently chosen that were believed to represent a range of lameness severities; no formal lameness scoring was conducted. One 20 second video clip was chosen for each of the sheep. Each clip was randomly assigned a number from 1 to 4. Four movies were created, each one containing the same four clips in a different order to reduce order bias (see Table 4.1). In addition each movie contained one additional clip, clip A, which was of a fifth sheep and was always seen first. Although unknown to the participants, this was used as a practice clip and the resulting data were not analysed. The purpose of clip A was twofold, firstly it acted as a practise for participants and secondly it provided a common start point.

Table 4.1 Sequence of Video Clips.

	Clip	Clip	Clip	Clip	Clip
Movie 1	A	4	1	2	3
Movie 2	A	3	1	2	3
Movie 3	A	2	3	1	2
Movie 4	A	1	2	3	4

2.3 Questionnaire

At the end of each clip the movie was paused and participants filled out a short, 4 question, questionnaire (Appendix V) about the sheep they had just watched. Participants were asked to place a downward line through each of the three visual analogue scales at a point they felt best represented: i) how lame they thought the animal was, from '*sound*' to '*couldn't be more lame*', ii) how much pain they thought the animal was in, from '*no pain*' to '*worst pain imaginable*' and iii) how much of a negative emotional reaction they had had, from '*no negative emotional reaction*' to *'strongest possible negative reaction'*. These three variables: lameness, pain and emotional reaction will, from now on, be collectively referred to as LPER. The fourth question was a multiple-choice question about whether they would catch the sheep to check its feet, (subsequently referred to as 'catch'). Participants were given as long as they needed to answer the questions after which the next clip was shown. The study received internal ethical approval from the School of Health in Social Science at the University of Edinburgh. The questionnaire is included in Appendix V.

2.4 Recruitment

Farmers (n=68) and veterinarians (n=46) were recruited at a number of events (Table 4.2). At the Royal Highland Show visitors to Scotland's Rural College (SRUC) stand were approached, and those that were sheep farmers or vets were given details of the study and asked if they would be willing to take part. Participants were entered into a prize draw for a £100 gift certificate. At the Sheep Veterinary Society's annual conference, delegates were provided with information about the study through i) a leaflet in their delegate pack, and ii) announcements made throughout the conference. Participants were entered into a prize draw for a bottle of whisky. Sheep farmers participating in an SRUC workshop on lameness were also asked to participate in the study. Undergraduate students (n=169) were recruited through their institution. The following data on student demographics were collected: age, gender, year of study, course, and college or university. The number of students from each course by gender and age is shown in Table 4.3.

Table 4.2 The location and number of participants recruited

Profession	Royal Highland Show	Sheep Veterinary Society	Lameness Workshop	Total
Farmers	44	1	23	68
Veterinarians	6	40	-	46
Students	**Edinburgh University**	**Harper Adams University**	**Scotland's Rural College**	
ABW	-	24	-	24
Agriculture	-	28	61	89
Veterinary	56	-	-	56

Table 4.3 The number of students from each course by gender and age

	Gender		Age (years)			
	Female	**Male**	**18-19**	**20-21**	**22-23**	**24+**
ABW	23	-	-	11	12	-
Agriculture	40	49	32	38	15	4
Veterinary	40	16	0	10	20	26
Total	103	65	32	59	47	30

2.5 Procedure

Participants either took part individually (n=91) or as part of a group (n=192). Individual participants were shown the movie on a laptop, and group participants were shown it using a projector and screen. The majority of farmers (n=45) and all the vets took part in the study individually; one facilitator took one participant through the study at a time, showing movie 1 to participant 1, movie 2 to participant 2 and so on. Since the farmers recruited at the lameness workshop watched the movie together at the same time, there is a potential that participants influenced each other's responses. However an analysis was run comparing those that took part as a group and those that took part independently and no differences were found. All the students participated as part of a group. There were six students groups in total, with each group being shown one of three movies.

3. Data & Statistical analysis

3.1 Data

Responses were inputted into Excel, and spreadsheets were cross-checked to remove errors. Data for the VAS questions were extracted by measuring the distance from the left end the scale to where the participants had placed their mark. For lameness, pain and emotional reaction, a score of zero indicated that the participant felt that the trait was entirely absent; whilst a score of 100 indicated that they felt the trait was present at its most severe..

3.2 Analysis

Statistical analyses were carried out in Genstat (16th Edition) using residual maximal likelihood (REML). Main effects were considered significant at $p<0.05$ and interactions at $p<0.01$. REML was utilised for statistical analysis as it does not require a balanced design and is well suited for studies with unequal group sizes such as this one, as well as its capacity to fit both random and fixed effects in the model. All possible interactions between fixed effects were investigated by running multiple iterations of the model. Non-significant interactions were removed and the model re-run until the simplest model was achieved, i.e. only the main effects and significant interactions remained. Normality of the data was assessed by inspection of the residuals. Post hoc analyses were conducted using least significant difference (LSD) tests.

3.3 Effect of 'ewe' and 'participant type' (profession/course)

The effect of 'ewe' and 'participant group' and the interaction between these two effects on the ratings of lameness, pain, and emotional reaction were investigated. In order to account for observer, and the order in which clips were viewed, these were fitted as random effects.

3.4 Effect of gender and age

The effect of gender and age on students' lameness, pain, and emotional reaction scores were investigated within course. The main effects of gender and age and the interaction between these two effects were investigated. Participant number, ewe, and the sequence in which clips were viewed were fitted as random effects to account for observer, ewe differences and order of clip viewed.

3.5 Decision to catch

The relationship between participants' decision to catch and how they rated lameness, pain, and emotional reaction was investigated. The main effects of 'ewe', 'catch' (yes, no or maybe) and 'participant group' and the interactions between these effects were investigated. Participant number and the sequence in which clips were viewed were fitted as random effects to account for observer and order of clip viewed.

4. Results

4.1 Recognition of lameness and relationship with pain and emotional response.

The aim to select video clips of ewes with a range of lameness severities was accomplished. The lameness scores assigned by participants significantly varied across the scale resulting in the ewes being labelled as 'sound', 'mildly lame', and two as 'moderate/severely lame' (Table 4.4). Spearman rank correlations showed strong positive correlations between all three assessed variables: lameness, pain and emotional reaction (Table 4.5).

Table 4.4 Mean (s.e.) scores for lameness, pain, and emotional reaction for each participant group for each ewe

Ewe	Sound (1)		Mild (2)		Moderate/ Severe (3)		Moderate/ Severe (4)	
	mean	se	mean	se	mean	se	mean	se
Lameness								
ABW students	8.7	(4.23)	12.9	(4.23)	71.7	(4.23)	64.4	(4.23)
Ag. students	8.3	(2.75)	17.5	(2.75)	69.4	(2.75)	76.1	(2.75)
Farmers	9.9	(2.84)	34.2	(2.85)	70.6	(2.85)	79.6	(2.84)
Vets	12.8	(3.10)	32.0	(3.10)	78.5	(3.10)	86.6	(3.10)
Vet students	21.4	(3.11)	26.5	(3.12)	79.8	(3.11)	79.1	(3.11)
Mean total	12.2	(3.21)	24.6	(3.21)	74.0	(3.21)	77.2	(3.21)
Pain								
ABW students	6.4	(4.36)	11.4	(4.36)	64.8	(4.36)	60.0	(4.36)
Ag. students	5.9	(2.90)	14.2	(2.90)	62.3	(2.90)	69.5	(2.90)
Farmers	10.0	(2.98)	30.2	(3.00)	67.2	(2.99)	72.1	(2.98)
Vets	10.6	(3.25)	30.1	(3.23)	74.0	(3.23)	81.9	(3.23)
Vet students	19.3	(3.26)	21.9	(3.26)	70.9	(3.27)	71.3	(3.26)
Mean total	10.4	(3.35)	21.6	(3.35)	67.8	(3.35)	71.0	(3.35)
Emotional reaction								
ABW students	6.8	(5.30)	10.1	(5.30)	52.0	(5.30)	46.0	(5.30)
Ag. students	3.8	(3.53)	6.4	(3.53)	32.4	(3.54)	39.7	(3.54)
Farmers	9.1	(3.64)	23.3	(3.66)	51.0	(3.65)	56.9	(3.64)
Vets	9.8	(3.95)	25.1	(3.95)	64.1	(3.95)	72.8	(3.95)
Vet students	16.2	(3.98)	19.5	(4.00)	59.4	(4.01)	61.6	(3.98)
Mean total	9.2	(4.08)	16.9	(4.09)	51.8	(4.09)	55.4	(4.08)

Table 4.5 Spearman rank correlations between participants' ratings of lameness, pain and their emotional reaction

	Farmers		Veterinarians		Students	
	r	*p*	*r*	*p*	*r*	*p*
Lameness & Pain	0.93	<0.001	0.95	<0.001	0.95	<0.001
Lameness & Emotional Reaction	0.81	<0.001	0.88	<0.001	0.95	<0.001
Pain & Emotional Reaction	0.84	<0.001	0.91	<0.001	0.80	<0.001

4.2 Decision to catch

The decision to catch varied between ewes, with 96% of participants saying 'yes' for the two 'moderate/severely lame' ewes and 81% answering 'maybe' or 'no' for the 'sound' ewe (Table 4.6). The majority of farmers (61%) and vets (74%) responded 'yes' for the 'mildly lame' ewe, however there was more variation within the student groups with 45% answering 'yes' and 55% answering 'maybe' or 'no'. Those who answered 'yes' to 'catch' rated LPER higher ($p<0.01$) than those who answered 'maybe' or 'no' (Figure 4.1).

Table 4.6 Farmers', veterinarians' and students' decisions on whether or not they would catch each of the ewes for inspection

	Sound			Mild			Moderate/Severe (3)			Moderate/Severe (4)		
	Yes	**Maybe**	**No**	**Yes**	**Maybe**	**No**	**Yes**	**Maybe**	**No**	**Yes**	**Maybe**	**No**
Farmers	13.4% (n=9)	22.4% (n=15)	64.2% (n=43)	60.6% (n=40)	19.7% (n=13)	19.7% (n=13)	98.5% (n=65)	1.5% (n=1)	0.0% (n=0)	100% (n=66)	0.0% (n=0)	0.0% (n=0)
Veterinarians	21.7% (n=10)	15.2% (n=7)	63.0% (n=29)	73.9% (n=34)	13.0% (n=6)	13.0% (n=6)	100% (n=46)	0.0% (n=0)	0.0% (n=0)	100% (n=46)	0.0% (n=0)	0.0% (n=0)
Students												
ABW	17.4% (n=4)	8.7% (n=2)	73.9% (n=17)	22.7% (n=5)	18.2% (n=4)	59.1% (n=13)	100% (n=23)	0.0% (n=0)	0.0% (n=0)	78.3% (n=18)	4.3% (n=1)	17.4% (n=5)
Agriculture	12.4% (n=11)	10.1% (n=9)	77.5% (n=69)	27.0% (n=24)	31.5% (n=28)	41.6% (n=37)	100% (n=88)	0.0% (n=0)	0.0% (n=0)	93.3% (n=83)	3.4% (n=3)	3.4% (n=3)
Veterinary	29.6% (n=16)	31.5% (n=17)	38.9% (n=21)	48.1% (n=26)	16.7% (n=9)	35.2% (n=19)	100% (n=53)	0.0% (n=0)	0.0% (n=0)	92.6% (n=50)	5.6% (n=3)	1.9% (n=1)

4.3 Farmers, vets & students – do they differ?

Analysis revealed significant interactions ($p<0.001$) (Table 4.7) between ewe and participant group showing differences between groups for lameness (Figure 4.2), pain (Figure 4.3), and emotional reaction (Figure 4.4) scores for the different ewes. Vets and vets students were more likely to rate LPER higher and agriculture students gave significantly lower scores than vet students for LPER for all four ewes ($p<0.05$) with the exception of lameness and pain ratings for one of the moderate/severely lame ewes (ewe 4). Farmers and vets gave similar lameness, pain and emotional reaction scores for the 'sound' and 'mildly lame' ewes but vets gave significantly higher scores ($p<0.05$) for the two 'moderate/severely lame' ewes.

Table 4.7. Effects of 'ewe' and 'group' on participants' lameness, pain, and emotional reaction scores

		Wald	f	df	p
Lameness	Ewe.Group	62.84	5.24	800.4	<0.001
Pain	Ewe.Group	52.57	4.38	809.5	<0.001
Emotional reaction	Ewe.Group	76.57	6.38	811.4	<0.001

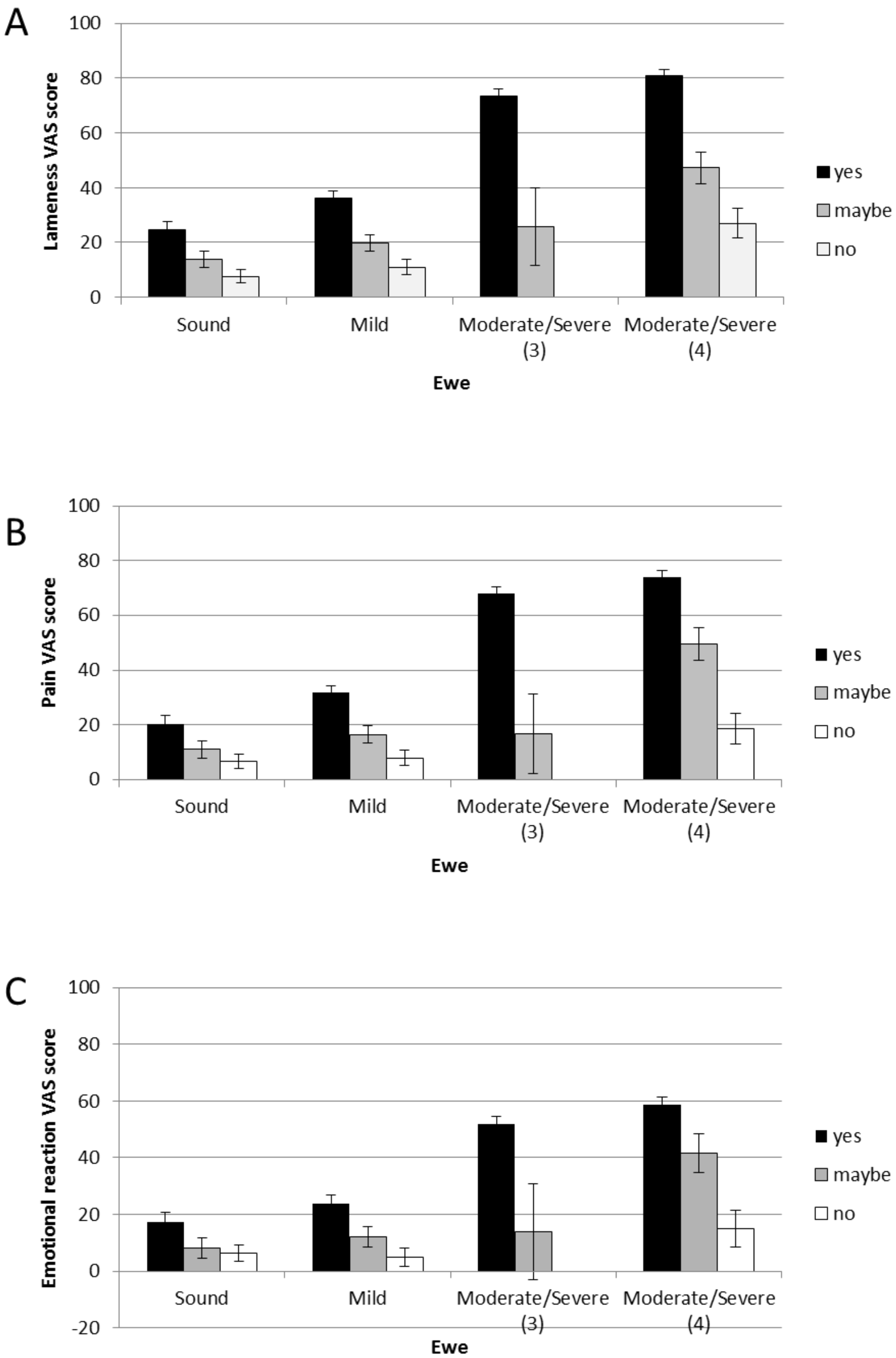

Figure 4.1 Relationship between decision to catch each ewe and mean (s.e.) A. lameness; B. pain; and C. emotional reaction scores. Participants who answered 'yes' to 'catch' rated LPER higher than those who answered 'maybe' or 'no' at p<0.01.

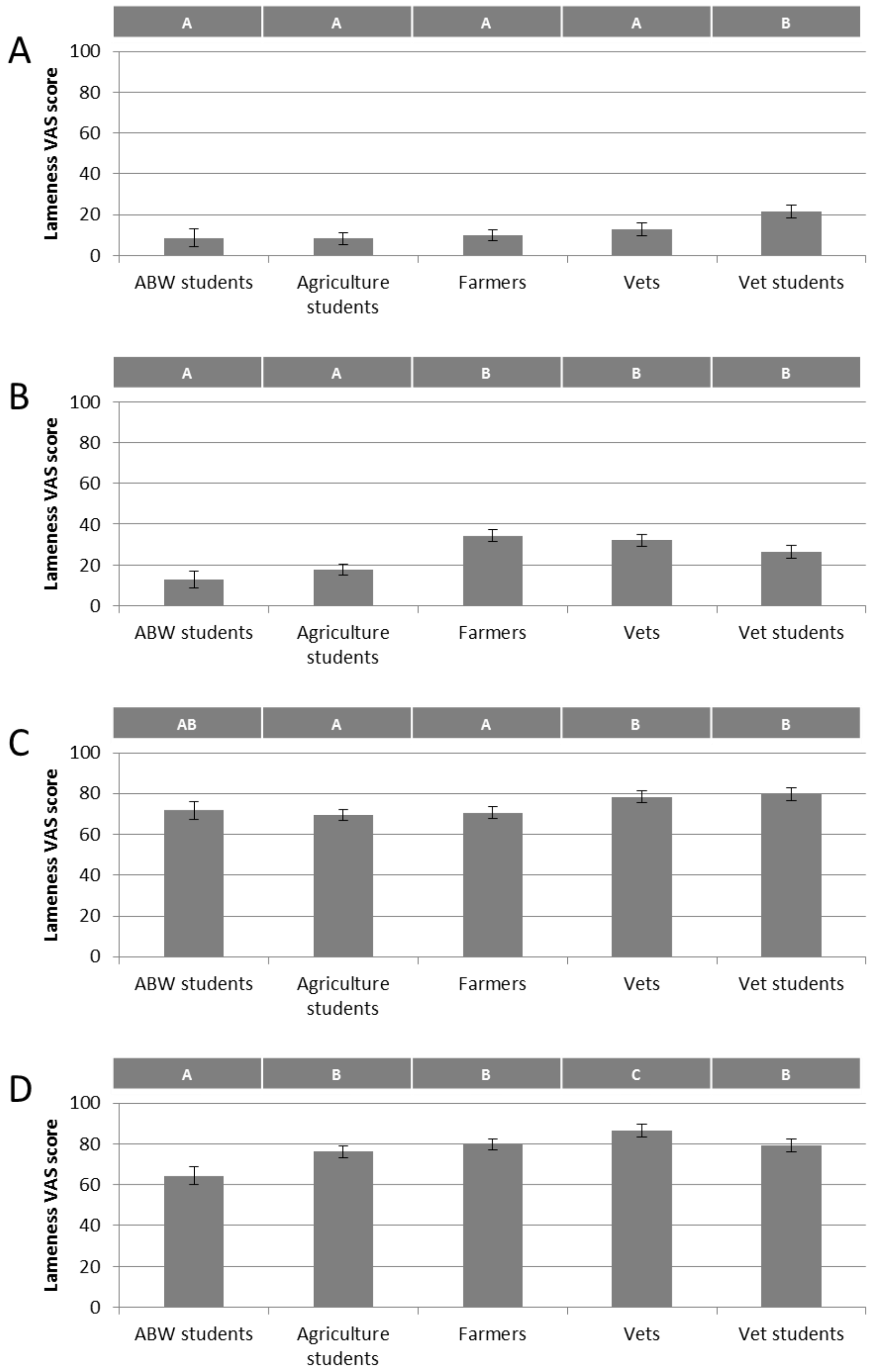

Figure 4.2 Mean (s.e.) lameness ratings for A: Sound; B: Mildly lame; C: Moderate/Severely lame (3); D: Moderate/Severely lame (4). Within ewe groups that do that share a letter are statistically different from each other at p≤0.05.

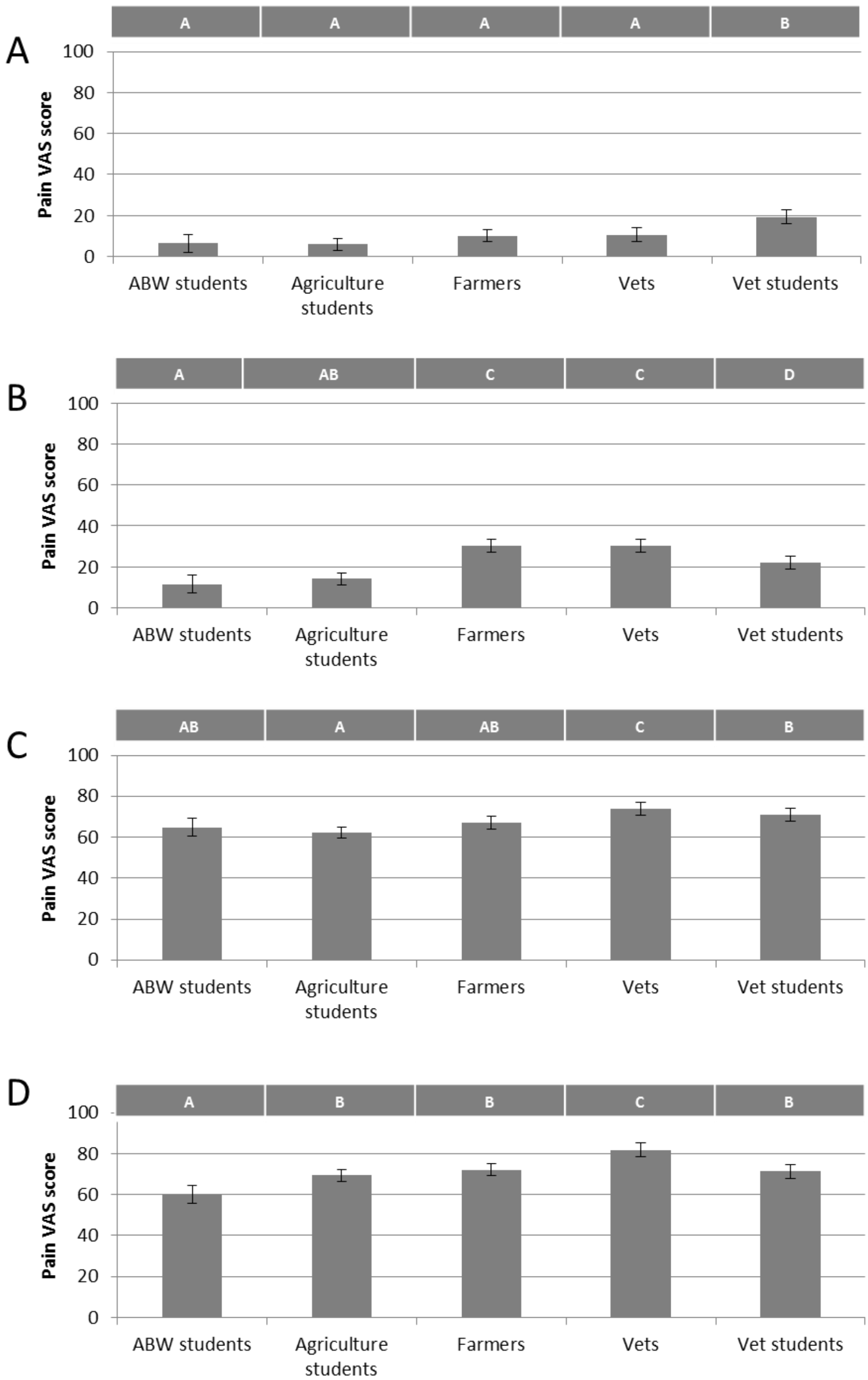

Figure 4.3 Mean (s.e) pain ratings for A: 'Sound'; B: 'Mildly lame'; C: Moderate/Severely lame (3); D: Moderate/Severely lame (4). Within ewe groups that do that share a letter are statistically different from each other at p≤0.05.

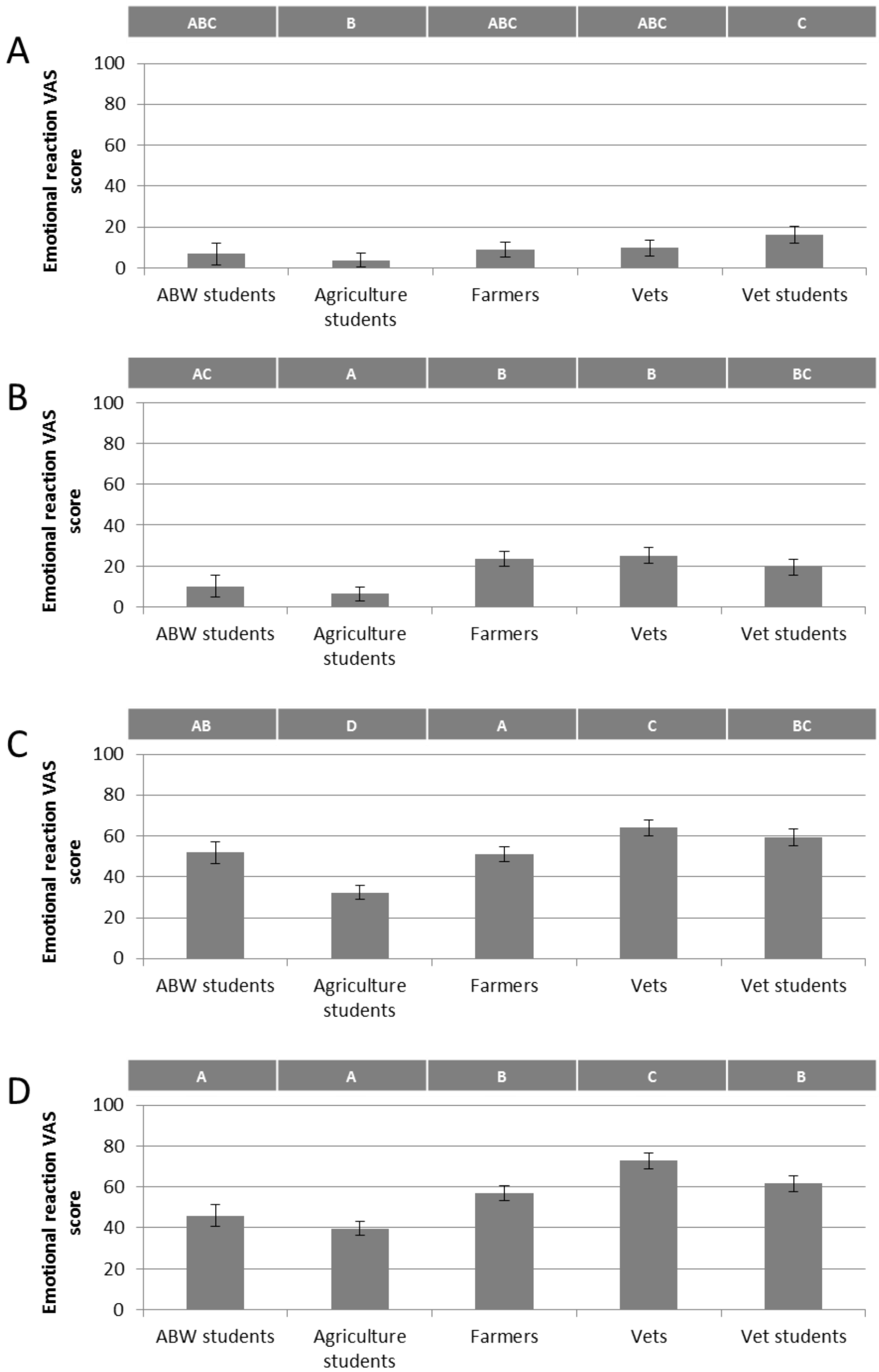

Figure 4.4 Mean (s.e.) emotional reaction ratings for A: 'Sound'; B: 'Mildly lame'; C: Moderate/Severely lame (3); D: Moderate/Severely lame (4). Within ewe groups that do that share a letter are statistically different from each other at p≤0.05.

4.4 Students - Gender & Age

There was no effect of age on lameness, pain, or emotional reaction scores for the ABW students (Table 4.8). There were no male ABW students so gender effects could not be investigated. No effect of age or gender was found for lameness and pain ratings given by agriculture students. However a significant interaction was found between age and gender (p=0.005) in how agriculture students rated their own emotional reaction. Female emotional reaction scores did not vary across age, but older males rated their emotional reaction higher than younger males. No effect of age or gender was found for the lameness, pain or emotional reaction scores of veterinary students.

Table 4.8 Effects of age and gender on ABW, agriculture and veterinary students' lameness, pain and emotional reaction scores.

		Wald	f	df	*p*
ABW students					
Lameness	Age	1.34	1.34	21.0	0.260
Pain	Age	2.01	2.01	21.0	0.171
Emotional reaction	Age	0.32	0.32	21.0	0.579
Agriculture students					
Lameness	Age	0.63	0.63	85.0	0.431
	Gender	0.01	0.01	85.0	0.909
Pain	Age	0.05	0.05	85.0	0.826
	Gender	0.67	0.67	85.0	0.415
Emotional reaction	Age.Gender	8.34	8.34	84.1	0.005
Veterinary students					
Lameness	Age	1.85	1.85	53.0	0.180
	Gender	0.89	0.89	53.0	0.349
Pain	Age	1.91	1.91	53.0	0.173
	Gender	0.02	0.02	53.4	0.887
Emotional reaction	Age	0.32	0.32	51.8	0.573
	Gender	2.47	2.47	52.0	0.122

5. Discussion

5.1 Summary of findings

The purpose of this study was to investigate farmers', vets', and students' perceptions of lameness and pain in sheep, and their emotional response to these factors, in order to better understand the affective element of lameness assessment. Results suggest that there is a relationship between these factors and that the decision to catch a lame sheep is affected by the observers' perceived severity of lameness and pain. Although analyses revealed a number of effects of age and gender on emotional reaction scores, these were not consistent across the different participant groups.

5.2 Recognition of lameness & the decision to catch

The video clips of ewes were chosen to represent a range of lameness severities in order to ascertain whether participants could recognise various lameness severities. The results of this study indicate that all five participant groups were able to identify these varying levels of lameness. This supports previous work that found that farmers and sheep specialists were able to distinguish between a range of lameness severities from video clips of sheep (Kaler and Green, 2008a). In addition the results show that farmers, vets and students perceive lameness to be a painful condition for sheep and that the perceived severity of the pain is closely correlated with the perceived severity of lameness, and with the raters' own emotional reaction. These findings suggest that even mild lameness is perceived to be painful. This may be an important finding as, as Kaler and Green (2008) suggest farmers may not ‘catch’ mildly lame sheep as they do not perceive them to be in pain. How participants scored lameness and pain and their subsequent decision to catch does suggest that a relationship exists, with those answering ‘yes’ to ‘catch’ scoring lameness and pain higher. Findings from the literature suggest an important relationship exists between observers’ assessment of pain and the subsequent decision to treat that pain, with those perceiving pain to be higher being more likely to provide analgesia (Susan E Dohoo and Dohoo, 1996; Hewson et al., 2007b; Huxley and Whay, 2006) A similar situation may be occurring here with participants who perceive a case of lameness as more severe being more likely to take action to treat the animal. Research on sheep farmers’ perspectives of lameness found that farmers considered improving welfare and reducing pain as the two most important motivators for treating lame sheep (King, 2013).

If participants are able to identify mildly lame sheep and recognize that even mild lameness is painful for the animal other factors are likely to be playing a role in whether these animals are caught and treated. This study found that 61% of farmers and 74% of vets wanted to catch the mildly lame ewe. However research suggests that mildly lame sheep are often not caught, especially if they are the only lame animal in a group (Kaler and Green, 2008a; King, 2013). Potential restrictions placed on farmers such as lack of time and appropriate facilities (Kaler and Green, 2008a) are likely to limit their ability to catch mildly lame sheep as well as the potential need to navigate rough terrain or deal with unfavorable weather conditions (Angell and Duncan, 2015). Substantially fewer students said 'yes' to catching the mildly lame sheep, than farmers or vets, they also gave lower lameness and pain scores which may explain their subsequent decision not to 'catch'. Encouraging and facilitating better management practices through improved access to and use of portable handling facilities and appropriate treatment will enable farmers to keep lameness prevalence low.

5.3 Comparisons between participant groups

Farmers and vets agreed in how they scored LPER for both the sound and mildly lame ewes; however vets scored LPER higher for the two moderate/severely lame ewes. This is perhaps surprising in light of the fact that almost 100% of farmers and vets said they would catch the two moderate/severely lame ewes but fewer farmers said they would catch the sound and mildly lame ewes compared to vets. When comparing agriculture and vet students a different relationship can be seen, here there is a greater level of agreement for the two moderate/severely lame ewes and the differences are for the sound and mildly lame ewes with vet students scoring lameness and pain higher. This difference can also be seen in participants' decision to 'catch', over 90% of agriculture and vet students said 'yes' to catching the two moderate/severely lame ewes but a higher percentage of vets, 78%, said they would 'catch' the sound and mildly lame ewe compared to only 39% of agriculture students. In addition vet students have higher emotional reaction scores for all four ewes.

5.4 Effects of Gender & Age

No gender or age effects were found on the pain ratings, which is in contrast to other studies that have found that females and younger participants rated pain higher (Capner et al., 1999; Huxley and Whay, 2006; Lascelles et al., 1999; Laven et al., 2009; Lorena et al., 2013; Raekallio et al., 2003), but supports the findings of other studies (Kielland et al., 2010; Muri and Valle, 2012). Gender differences do not appear to be consistent and, identifying them may be hampered where gender imbalance exists as is the case here, with 61% of the participants being female. There were no male ABW students, and less than 30% of veterinary students were male. The most balanced group was agriculture students with 45% females and 55% males and an interaction between age and gender was found for this group. The emotional reaction scores of females were found to be consistent with age, but for males they increased with age. Although not directly comparable, Paul and Podberscek (2000) found the opposite pattern in vet students, where although females maintained their empathy levels across their years in veterinary education males had declining empathy levels most notably in their final clinical year.

6. Conclusion

Results support the findings of previous research that farmers and vets can distinguish between different severities of lameness in sheep. This study contributes to the literature through the addition of ABW, vet and agriculture students who show a similar pattern of lameness scoring as farmers and vets showing that they too can distinguish between different lameness severities. Participants perceived lameness to be a painful condition, the level of which being closely correlated with the severity of lameness. This finding does not support the theory that lameness prevalence remains high because farmers do not perceive it to be painful for affected sheep. However participants who said they would catch a ewe for inspection gave higher lameness, pain and emotional reaction scores implying an important, if not surprising, relationship between how an observer perceives the condition of a sheep and their subsequent decision to catch. This may have important implications for lameness management.

Study Two

Aims & Research questions

To develop novel multi-item rating scales for the assessment of attitudes and empathy towards lameness and pain in sheep, and to subsequently investigate the relationship with analgesic provision.

1. Do farmers and vets differ in their attitudes, empathy and compassion towards lameness and pain in sheep?
2. Is there a relationship between farmers' and vets' attitudes and empathy towards lameness and pain in sheep and their lameness treatment decisions?

7. Methodology

7.1 Overview

Farmers and veterinarians watched a video clip of a lame sheep (ewe 3 from study one) and, using a 100mm VAS, rated the pain they felt the sheep was experiencing. They then completed a more detailed questionnaire about their attitudes toward pain, analgesic use and their management and treatment practices concerning lameness.

7.2 Recruitment

The study was piloted in June 2014 at the ScotSheep event in the Scottish Borders. Participants (Table 4.9), sheep farmers and vets, were recruited between October and December 2014 via an email invitation containing details of, and a web link to, the questionnaire. A prize of a £100 gift voucher was offered as an incentive to encourage participation.

Table 4.9 Number of people that were emailed with the questionnaire invitation

	Number of people contacted
Subscribers of the National Sheep Association Newsletter	~3000
Members of the Sheep Veterinary Society Online Forum	Unknown
Sheep Veterinary Society Meeting Delegates (September 2013 & May 2014)	190
Database of farmers who had taken part in our previous research	170

7.3 Questionnaire

7.3.1 Theory of planned behaviour

The farmer questionnaire is included in Appendix VI, the veterinary questionnaire in Appendix VII. Part of the questionnaire was developed using the theory of planned behaviour model (TPB). It contained thirty-four questions relating to: *behaviour:* participants' routine lameness management (19 questions); *behavioural intention*: elicited by a video and photograph scenario of a lame sheep (9); *perceived control*: the level of control they felt they had over analgesia provision (3); and *subjective norm*: the perceived social pressure to provide analgesics to lame sheep (3). The '*behaviour*' section included a question asking participants how frequently they used (farmers) or recommend the use of (vets) analgesia as part of the treatment of lame sheep. The '*behavioural intention*' section asked participants whether they would give analgesia to the sheep in the video. The study received ethical approval from SRUC's Animal Ethics Committee and human ethical approval from the School of Health in Social Science at the University of Edinburgh. The questionnaire is included in Appendix VI and VII.

7.3.2 Farmer/Vet Relationship

The questionnaire contained four questions relating to the relationship that existed between farmers and their vets. Participants were also asked how many times they had called a vet out (farmers) or been called out (vets) in the previous twelve months for lame sheep.

7.3.3 Attitudes

The questionnaire contained twenty-two attitudinal statements adapted and developed to look at: attitudes to pain in sheep (4), attitudes to analgesic provision for lame sheep (2), and the perceived benefits (4) of, and barriers (4) to analgesic provision (Table 4.10).

7.3.4 Empathy

The questionnaire contained fifteen statements designed to assess the cognitive, affective and compassionate components of empathy (Table 4.11). The ten cognitive and affective items of the scale were adapted from of a scale developed by Muri et al. (2012) to look at the empathy of goat farmers in Norway, which was an adaption of Paul's (2000) Animal Empathy Scale, which was itself based on the Questionnaire for the Measurement of Emotional Empathy (QMEE) (Mehrabian and Epstein, 1972) in humans. The additional five statements pertained to compassionate empathy. Three of these statements were adapted from human-orientated compassion scales: one from the compassion scale (Pommier, 2010) and two from the compassionate love scale (Fehr and Sprecher, 2009)). Two were original statements.

Table 4.10 Attitudinal items: adaption and creation

Statement	Adapted from
Lame sheep benefit from pain relief as part of their treatment	Raekallio et al., 2003; Thomsen et al., 2012, 2010; Whay and Huxley, 2005 Farmer questionnaire chapter 2
Including pain relief in the treatment of lame ewes improves their performance	Developed for study
Including pain relief in the treatment of lame ewes improves their lamb's performance	Developed for study
Including pain relief in the treatment of lame ewes improves their welfare	Developed for study
Some degree of pain is beneficial to sheep	Raekallio et al., 2003; Thomsen et al., 2012 Farmer questionnaire chapter 2
Sheep experience pain in the same way as humans	Kielland et al., 2010; Ison and Rutherford, 2014
Treating the disease is the same as alleviating the pain	Developed for study
It is difficult to recognise pain in sheep	Developed for Farmer questionnaire chapter 2
Pain relieving drugs are not necessary for lame sheep	Developed for Farmer questionnaire chapter 2
I think that pain relief should be part of the treatment of lame sheep	Developed for study
If pain relieving drugs were cheaper I would use them when treating lame sheep	Whay and Huxley, 2005
In general farmers would use pain relieving drugs more often when treating lame sheep if they were cheaper	Whay and Huxley, 2005

Table 4.11 Empathy and compassion items: adaption and creation

Statement	Goats empathy scale (Muri et al., 2012)	Animal empathy scale (Paul, 2000)
It upsets me to see or hear about sheep that have been attacked or killed by dogs	It upsets me to see and hear about goats that have been killed by predators	It upsets me to see animals being chased and killed by lions in wildlife programs on TV
It makes me sad to see sheep isolated from the rest of the flock	It makes me sad to see goats isolated from the rest of the flock	It makes me sad to see an animal on its own in a cage
Farmers that talk to their sheep annoy me	Farmers that talk to and cuddle their goats annoy me	People who cuddle and kiss their pets in public annoy me.
It upsets me to see sick sheep	It upsets me to see helpless sick goats	It upsets me when I see helpless old animals.
Many farmers are over affectionate towards their animals	Many farmers are over affectionate about their animals	Many people are over-affectionate towards their pets.
It is silly to become emotionally attached to a sheep	It is silly to become attached to a goat	It is silly to become too attached to one's pets.
Seeing healthy sheep nearly always puts me in a good mood	I will almost always get in a good mood when I see healthy and happy goats	Pets have a great influence on my moods
People often make too much of the feelings of sheep	People often make too much of the feelings of goats	People often make too much of the feelings and sensitivities of animals.
It irritates me when pet lambs play around my feet	I find it irritating when goat kids jump up on me to play	I find it irritating when dogs try to greet me by jumping up and licking me.
I enjoy patting or stroking pet lambs	I enjoy patting/stroking goats	I enjoy feeding scraps of food to the birds.

Table 4.12 (*continued*) Empathy and compassion items: adaption and creation

Statement	Compassionate love scale (Fehr and Sprecher, 2009)
As a farmer I get personal satisfaction from helping sheep in pain or distress	One of the activities that provide me with the most meaning to my life is helping others in the world when they need help
When a sheep is in pain or distress I want to help it	When I see people I do not know feeling sad, I feel I need to reach out to them
	Compassion Scale (Pommier, 2010)
I don't like being around sheep when they are in pain	I try to avoid people who are experiencing a lot of pain
I do all I can to reduce the amount of stress sheep experience from gathering or handling	Developed for study
Trying to limit the fear sheep experience is a waste of time as they are naturally fearful	Developed for study

7.3.5 Demographics

A number of personal and professional demographic data were collected. For farmers, data were collected on: age, gender, country of residency, education, profession, number of years working with sheep, and number of breeding ewes. For vets, data were collected on: age, gender, country of residency, education, year of graduation, size of vet practice, percentage of sheep work, and whether they were a sheep specialist. In addition all participants were asked whether they were both a sheep farmer and a vet.

7.3.6 Question Responses

Responses to questions were in the format of either: multiple choice, Likert Scale, or open response. With the exception of demographic questions, all multiple choice questions were posed in the format of either: "yes or no", "true or false", or frequency i.e. "always/almost always, often, sometimes, rarely, never". Likert Scale response questions were posed as: "Completely Agree to Completely Disagree", "Highly approve to Highly Disapprove", "Total Control to No Control", "Very Confident to "Not at all Confident", and "Very Likely to Not at all Likely". They were all on a six point Likert scale, with the exception of the Attitude statements which also included a 'Don't Know' option. Each page of the questionnaire also contained a comment box encouraging participants to expand on any of their answers or make comments.

8. Data & Statistical analysis

8.1 Data

Data were recorded automatically in electronic format by Snap webhost. Responses were then downloaded back into Snap survey software and exported into excel where they were checked for errors. There were three (out of 990) missing values in the final empathy & compassion scale. As Principal Component Analysis cannot generate factor scores for participants with missing data these missing values were entered with the participant's mean score from the other items in that factor. 'Don't know' answers were treated as missing data, but were left blank.

8.2 Analysis

Principal component analyses and Cronbach alpha's reliability testing were conducted in SPSS (22nd edition). Statistical analyses carried out in Genstat (16th Edition) included, residual maximal likelihood (REML), Kruskal-Wallis and Spearman rank correlations. Main effects were considered significant at $p<0.05$ and interactions at $p<0.01$. Post hoc analyses were conducted using least significant difference (LSD) tests.

8.2.1 Attitude and empathy scales

The Kaiser-Meyer-Olkin measure of sampling adequacy indicated that the items in the attitude and empathy scale had adequate commonalities to warrant component analysis. Bartlett's test of sphericity also showed that there were adequate correlations between items. Exploratory Principal Component Analysis (PCA) was conducted on the data allowing for a large number of variables to be reduced into a smaller number of components. Initially eigenvalues above 1.0 were extracted, resulting in two components. Parallel analysis was then conducted to ascertain the statistically significant eigenvalues. Parallel analysis is considered superior to other techniques for identifying the number of components to retain, notably the Scree test or the Kaiser's eigenvalue-greater-than-one rule (Ledesma and Valero-Mora, 2007). Parallel analysis identified one component for the attitude scale, and three for the empathy & compassion scale. PCA was re-run on the two separate scales this time extracting one component from the attitude scale and three from the empathy & compassion scale. Regression factor scores for each of the four components were generated for each participant. The factor scores are composite variables which provide information about an individual's placements on each of the components (DiStefano et al. 2009). High factor scores represented the most positive attitudes and low scores the least positive. A Spearman rank correlation was performed on the three components extracted from the empathy & compassion scale to test for correlations between them. No significant correlations were found ($r2<0.079$, $p>0.435$). Therefore the PCA was re-run using a Varimax rotation with Kaiser normalisation which assumes no correlations between components and uses an orthogonal rotation to achieve a simple structure end point solution. No rotation was used for the attitude scales as only one component was extracted.

Cronbach Alpha's test for internal reliability was performed on each of the four subscales. This method tests how closely related a set of items are as a group and, whether the items are consistent in what they are measuring. Items with factor loadings below 0.6 were excluded from the attitude sub-scale and two of the three empathy & compassion sub – scales, resulting in high internal reliability >0.718. For the third empathy & compassion sub-scale, a factor loading cut off of 0.4 was used as there were only three items in the scale, which is the minimum recommended requirement for a sub-scale. The Cronbach Alpha internal reliability for this scale was 0.6 which is considered adequate for a novel psychological scale. Two statements were removed from the second empathy & compassion component as they did not logically fit with the other items and their presence did not greatly improve the internal reliability of the scale.

The strength of the relationship between each of these subscales and how participants rated the level of pain the sheep in the video was experience was measured using a spearman rank correlation.

8.2.2 Age, gender & profession

REML was utilised for statistical analysis as it does not require a balanced design and is well suited for studies with unequal group sizes such as this one, as well as its capacity to fit both random and fixed effects in the model. All possible interactions between fixed effects were investigated by running multiple iterations of the model. Non-significant interactions were removed and the model re-run until the simplest model was achieved, i.e. only the main effects and significant interactions remained. The distribution of all four factor score data and the pain data were found to be approximately normal as assessed by inspection of residuals plots. Separate analyses were run for each of the four components and the pain scores. These data were fitted as the Y variates. Age (covariate), gender and profession were fitted as fixed effects and were all factors. Interactions between fixed effects were investigated and if found to be non-significant were removed from the model.

8.2.3 Decision to administer analgesia to the lame sheep

Kruskal-Wallis as an appropriate non-parametric test to investigate potential differences between multiple groups was used to investigate the relationship between whether or not participants said they would treat the lame sheep from the video with analgesia and their attitudes, empathy and pain ratings.

8.2.4 Frequency of analgesic use

Spearman rank correlations were run to investigate the relationship between attitudes, empathy, pain ratings, self-efficacy (perceived control) and social norms (subjective norms) and how frequently participants reported giving analgesia as part of lameness management on their farms (farmers) or when treating clients sheep (vets).

9. Results

A total of 63 farmers and 54 veterinarians participated. Seven farmers were excluded from analysis due to a high proportion of missing answers (≥50%). Fourteen vets were excluded from analysis: 2 were not residents of the British Isles and 12 were not practitioners. This resulted in a data set consisting of 56 farmers and 40 vets (Table 4.13).

Table 4.13 Mean (range) age of participants and the percentage (number) of female and male participants.

	Age in years	Gender	
		Female	Male
Farmers	49 (20-75)	30.4 *(n=17)*	69.6 *(n=39)*
Veterinarians	38 (23-72)	64.1 *(n=25)*	35.9 *(n=14)*
Total		44.2 *(n=42)*	55.8 *(n=53)*

Table 4.13 contains the scale outcomes from the PCA Cronbach Alpha reliability testing. The analyses identified three sub-scales from the empathy and compassion items, and one sub-scale from the attitude items. The three empathy and compassion sub-scales have been labelled as: '*Affective empathy*', '*Judgement of others*' (judgement), and '*Compassion*'. The attitude sub-scale has been labelled '*Benefits of analgesic use*' (benefits).

Table 4.14 Factor loadings and means scores (standard deviation) of each item from the 'benefits', 'affective empathy', 'judgement of others' and 'compassion' components. Including eigenvalues and Cronbach's alpha (α) internal reliability of each component

	Loading	Mean (±SD)	Eigenvalue	α
Benefits of analgesic use (n=54)			3.30	0.84
Lame sheep benefit from pain relief as part of their treatment[ƚ]	0.89	5.67 (0.70)		
Including pain relief in the treatment of lame ewes improves their performance[ƚ]	0.80	5.67 (0.64)		
Including pain relief in the treatment of lame ewes improves their lamb's performance[ƚ]	0.70	5.39 (0.81)		
Including pain relief in the treatment of lame ewes improves their welfare[ƚ]	0.77	5.74 (0.52)		
I think that pain relief should be part of the treatment of lame sheep[ƚ]	0.81	5.37 (0.94)		
Affective empathy (n=90)			2.36	0.74
It upsets me to see or hear about sheep that have been attacked or killed by dogs[ƚ]	0.80	5.56 (0.97)		
It upsets me to see sick sheep[ƚ]	0.66	5.16 (1.17)		
Seeing healthy sheep nearly always puts me in a good mood[ƚ]	0.69	5.64 (0.77)		
As a farmer/Vet I get great personal satisfaction from helping sheep in pain or distress[ƚ]	0.79	5.64 (0.85)		
Judgement of others (n=90)			1.93	0.72
It is silly to become emotionally attached to a sheep	0.83	3.99 (1.57)		
Vets/Farmers that talk to their sheep annoy me	0.79	4.88 (1.48)		
People often make too much of the feelings of sheep	0.78	4.47 (1.34)		
Compassion (n=91)			1.81	0.60
When a sheep is in pain or distress I want to help it[ƚ]	0.88	5.81 (0.54)		
I do all I can to reduce the amount of stress sheep experience from gathering or handling[ƚ]	0.92	5.51 (0.79)		
Trying to limit the fear sheep experience is a waste of time as they are naturally fearful	0.43	5.22 (1.61)		

Participants' responses for each section are detailed in the following tables: knowledge (Table 4.15); treatment of lame sheep from video (behavioural intention) (Table 4.16); frequency with which farmers called out vets for lame sheep (Table 4.17); frequency with which vets were called out by farmers for lame sheep (Table 4.18); standard lameness management over prior 12 months (Table 4.19); infectious lameness management of prior 12 months (Table 4.20); empathy and compassion (Table 4.21); attitudes (Table 4.24); farmer/vet relationship (Table 4.26); social/subjective norms (Table 4.27); self-efficacy/perceived control (Table 4.28).

Table 4.15 Percentage *(*number) of farmers & veterinarians in response to questions regarding their knowledge surrounding the availability, use and storage of pain relieving drugs

Knowledge Statements		**Percentage (number)**		
	Profession	***True***	***False***	***Don't Know***
There are no pain relieving drugs available for use in sheep	**Farmer *(n=51)***	13.7 *(n=7)*	62.7 *(n=32)*	23.5 *(n=12)*
	Veterinarian *(n=38)*	23.7 *(n=9)*	73.7 *(n=28)*	2.6 *(n=1)*
Pain relieving drugs have to be administered by vets	**Farmer *(n=51)***	11.8 *(n=6)*	76.5 *(n=39)*	11.8 *(n=6)*
	Veterinarian *(n=38)*	0.0 *(n=0)*	100 *(n=38)*	0.0 *(n=0)*
Farmers are not permitted to keep pain relieving drugs on farm	**Farmer *(n=51)***	9.8 *(n=5)*	76.5 *(n=39)*	13.7 *(n=7)*
	Veterinarian *(n=38)*	5.3 *(n=2)*	92.1 *(n=35)*	2.6 *(n=1)*

Table 4.16 Percentage (number) of farmers & veterinarians in their response to 9 treatment options for the lame sheep from the video (behavioural intention)

Treatment options for lame sheep from video (behavioural intention)		Percentage (number)		
		Yes	Maybe	No
Spray foot an antibiotic/disinfectant spray	**Farmer (n=54)**	88.9 *(n=48)*	0% *(n=0)*	11.1 *(n=6)*
	Veterinarian (n=40)	95.0 *(n=38)*	2.5 *(n=1)*	2.5 *(n=1)*
Inject with an antibiotic	**Farmer (n=55)**	61.8 *(n=34)*	12.7 *(n=7)*	25.50 *(n=14)*
	Veterinarian (n=40)	90.0 *(n=36)*	5.0 *(n=2)*	5.0 *(n=2)*
Give an anti-inflammatory/ pain relieving drug	**Farmer (n=51)**	19.6 *(n=10)*	37.3 *(n=19)*	43.1 *(n=22)*
	Veterinarian (n=40)	70.0 *(n=28)*	15.0 *(n=6)*	15.0 *(n=6)*
Trim hoof	**Farmer (n=52)**	1.9 *(n=1)*	59.6 *(n=31)*	38.5 *(n=20)*
	Veterinarian (n=40)	2.5 *(n=1)*	2.5 *(n=1)*	95.0 *(n=38)*
Footbathe	**Farmer (n=54)**	24.1 *(n=13)*	29.6 *(n=16)*	46.3 *(n=25)*
	Veterinarian (n=40)	7.5 *(n=3)*	17.5 *(n=7)*	75.0 *(n=30)*
Separate her from the rest of the flock	**Farmer (n=53)**	47.2 *(n=25)*	26.4 *(n=14)*	26.4 *(n=14)*
	Veterinarian (n=40)	57.5 *(n=23)*	20.0 *(n=8)*	22.5 *(n=9)*
Turn her back out with the flock	**Farmer (n=53)**	34.0 *(n=18)*	30.2 *(n=16)*	35.8 *(n=19)*
	Veterinarian (n=39)	12.8 *(n=5)*	20.5 *(n=8)*	66.7 *(n=26)*
Cull her	**Farmer (n=52)**	5.8 *(n=3)*	44.2 *(n=23)*	50.0 *(n=26)*
	Veterinarian (n=40)	0.0 *(n=0)*	20.0 *(n=8)*	80.0 *(n=32)*
Get the vet out	**Farmer (n=52)**	0.0 *(n=0)*	67.3 *(n=35)*	32.7 *(n=17)*
Call another vet	**Veterinarian (n=40)**	0 *(n=0)*	0 *(n=0)*	100 *(n=40)*

Table 4.17 The frequency with which farmers said they had called out a vet for lame sheep over the previous 12 month period

Number of times vet was called (range 0 -2)	Farmers	
	Percentage (number)	
0	90.4	*(n=47)*
1	5.8	*(n=3)*
2	3.8	*(n=2)*

Table 4.18 The frequency with which vets said they had called out by farmers for lame sheep over the previous 12 month period

Number of times vet was called (range 0 - 50)	Vets	
	Percentage (number)	
0	17.1	*(n=6)*
1-5	42.9	*(n=15)*
6-10	22.9	*(n=8)*
>10	17.1	*(n=6)*

Table 4.19 The frequency with which farmers and veterinarians reported using 5 standard lameness management techniques on theirs/their clients' farms over the previous 12 month period.

Treatment options for standard lameness management	Profession	Percentage		
		Yes	No	N/A
Routine foot trimming whole flock	**Farmer *(n=54)***	29.6 *(n=16)*	70.4 *(n=38)*	0.0 *(n=0)*
	Veterinarian *(n=40)*	7.5 *(n=3)*	92.5 *(n=37)*	0.0 *(n=0)*
Routine footbathing whole flock	**Farmer *(n=55)***	65.5 *(n=36)*	34.5 *(n=19)*	0.0 *(n=0)*
	Veterinarian *(n=39)*	74.4 *(n=29)*	25.6 *(n=10)*	0.0 *(n=0)*
Vaccinating against footrot	**Farmer *(n=55)***	14.5 *(n=8)*	85.5 *(n=47)*	0.0 *(n=0)*
	Veterinarian *(n=40)*	65.0 *(n=26)*	32.5 *(n=13)*	2.5 *(n=1)*
Applying lime e.g. to pens/races/around feeders	**Farmer *(n=54)***	29.6 *(n=16)*	70.4 *(n=38)*	0.0 *(n=0)*
	Veterinarian *(n=39)*	61.5 *(n=24)*	38.5 *(n=15)*	1.9 *(n=1)*
Moving around mineral buckets or feeders in fields	**Farmer *(n=55)***	63.6 *(n=35)*	18.2 *(n=10)*	18.2 *(n=10)*
	Veterinarian *(n=39)*	82.1 *(n=32)*	17.9 *(n=7)*	0.0 *(n=0)*

Table 4.20 The frequency with which farmers and veterinarians reported using 11 infectious lameness management techniques on theirs/their clients' farms over the previous 12 month period.

Treatment options for infectious lameness management	Profession	Percentage				
		Always/Almost Always	***Often***	***Sometimes***	***Rarely***	***Never***
Therapeutic trimming individuals	**Farmer**	15.8	21.1	29.8	22.8	5.3
	(n=53)	*(n=9)*	*(n=12)*	*(n=17)*	*(n=13)*	*(n=3)*
	Veterinarian	5.8	9.6	28.8	34.6	17.3
	(n=38)	*(n=3)*	*(n=5)*	*(n=15)*	*(n=18)*	*(n=9)*
Footbathing infected individuals	**Farmer**	21.1	19.3	15.8	17.5	21.1
	(n=53)	*(n=12)*	*(n=11)*	*(n=9)*	*(n=10)*	*(n=12)*
	Veterinarian	11.5	23.1	36.5	19.2	7.7
	(n=39)	*(n=6)*	*(n=12)*	*(n=19)*	*(n=10)*	*(n=4)*
Using antibiotic or disinfectant foot spray	**Farmer**	43.9	28.1	17.5	0.0	5.3
	(n=53)	*(n=25)*	*(n=16)*	*(n=10)*	*(n=0)*	*(n=3)*
	Veterinarian	65.4	23.1	11.5	0.0	0.0
	(n=40)	*(n=34)*	*(n=12)*	*(n=6)*	*(n=0)*	*(n=0)*
Using antibiotic injections	**Farmer**	17.5	26.3	36.8	7.0	8.8
	(n=54)	*(n=10)*	*(n=15)*	*(n=21)*	*(n=4)*	*(n=5)*
	Veterinarian	57.7	38.5	3.8	0.0	0.0
	(n=40)	*(n=30)*	*(n=20)*	*(n=2)*	*(n=0)*	*(n=0)*
Separating lame ewes from the rest of flock	**Farmer**	12.3	14.0	33.3	24.6	14.0
	(n=55)	*(n=7)*	*(n=8)*	*(n=19)*	*(n=14)*	*(n=8)*
	Veterinarian	40.4	30.8	19.2	9.6	0.0
	(n=40)	*(n=21)*	*(n=16)*	*(n=10)*	*(n=5)*	*(n=0)*
Quarantine of new stock	**Farmer**	68.4	12.3	5.3	3.5	5.3
	(n=53)	*(n=39)*	*(n=7)*	*(n=3)*	*(n=2)*	*(n=3)*
	Veterinarian	82.7	5.8	7.7	3.8	0.0
	(n=40)	*(n=43)*	*(n=3)*	*(n=4)*	*(n=2)*	*(n=0)*
Turning treated animals out onto a clean and dry area	**Farmer**	29.8	36.8	17.5	7.0	5.3
	(n=54)	*(n=17)*	*(n=21)*	*(n=10)*	*(n=4)*	*(n=3)*
	Veterinarian	50.0	23.1	19.2	5.8	0.0
	(n=39)	*(n=26)*	*(n=12)*	*(n=10)*	*(n=3)*	*(n=0)*
Catching and treating mildly lame sheep	**Farmer**	24.6	45.6	19.3	3.5	5.3
	(n=55)	*(n=14)*	*(n=26)*	*(n=11)*	*(n=2)*	*(n=0)*
	Veterinarian	57.7	19.2	19.2	1.9	0.0
	(n=39)	*(n=30)*	*(n=10)*	*(n=10)*	*(n=1)*	*(n=0)*
Culling repeatedly lame sheep	**Farmer**	38.6	17.5	19.3	15.8	7.0
	(n=55)	*(n=22)*	*(n=10)*	*(n=11)*	*(n=9)*	*(n=4)*
	Veterinarian	69.2	23.1	3.8	0.0	1.9
	(n=39)	*(n=36)*	*(n=12)*	*(n=2)*	*(n=0)*	*(n=0)*
Treating lame sheep within 3 days of noticing them	**Farmer**	29.8	36.8	26.3	3.5	1.8
	(n=55)	*(n=17)*	*(n=21)*	*(n=15)*	*(n=2)*	*(n=1)*
	Veterinarian	67.3	26.9	1.9	3.8	0.0
	(n=40)	*(n=35)*	*(n=14)*	*(n=1)*	*(n=2)*	*(n=0)*
Giving anti-inflammatories /pain relieving drugs as part of lameness treatment	**Farmer**	1.8	17.5	19.3	17.5	40.4
	(n=54)	*(n=1)*	*(n=10)*	*(n=11)*	*(n=10)*	*(n=23)*
	Veterinarian	26.9	32.7	30.8	5.8	3.8
	(n=40)	*(n=14)*	*(n=17)*	*(n=16)*	*(n=3)*	*(n=2)*

Table 4.21 Percentage (number) of farmers & veterinarians in agreement with 15 statements pertaining to empathy and compassion towards sheep

	Profession	*Completely Agree* *1*	*2*	*3*	*4*	*5*	*Completely Disagree* *6*
It upsets me to see or hear about sheep that have been attacked or killed by dogs	**Farmer (n=51)**	84.3% *(n=43)*	7.8% *(n=4)*	0.0% *(n=0)*	2.0% *(n=1)*	5.9% *(n=3)*	0.0% *(n=0)*
	Veterinarian (n=40)	62.5% *(n=25)*	30.0% *(n=12)*	2.5% *(n=1)*	2.5% *(n=1)*	2.5% *(n=1)*	0.0% *(n=0)*
Vets/Farmers that talk to their sheep annoy me	**Farmer (n=50)**	0.0% *(n=0)*	4.0% *(n=2)*	16.0% *(n=8*	8.0% *(n=4)*	8.0% *(n=4)*	64.0% *(n=32)*
	Veterinarian (n=40)	5.0% *(n=2)*	2.5% *(n=1)*	25.0% *(n=10)*	12.5% *(n=5)*	2.5% *(n=1)*	52.5% *(n=21)*
It makes me sad to see sheep isolated from the rest of the flock	**Farmer (n=51)**	31.4% *(n=16*	11.8% *(n=6)*	9.8% *(n=5)*	13.7% *(n=7)*	17.6% *(n=9)*	15.7% *(n=8)*
	Veterinarian (n=40)	17.5% *(n=7)*	17.5% *(n=7)*	7.5% *(n=3)*	25.0% *(n=10)*	17.5% *(n=7)*	15.0% *(n=6)*
Many vets/farmers are over affectionate towards their sheep	**Farmer (n=51)**	3.9% *(n=2)*	2.0% *(n=1)*	15.7% *(n=8)*	11.8% *(n=6)*	31.4% *(n=16)*	35.3% *(n=18)*
	Veterinarian (n=40)	0.0% *(n=0)*	0.0% *(n=0)*	12.5% *(n=5)*	15.0% *(n=6)*	35.0% *(n=14)*	37.5% *(n=15)*
It upsets me to see sick sheep	**Farmer (n=50)**	60.0% *(n=30)*	26.0% *(n=13)*	6.0% *(n=3)*	2.0% *(n=1)*	4.0% *(n=2)*	2.0% *(n=1)*
	Veterinarian (n=40)	42.5% *(n=17)*	30.0% *(n=12)*	15.0% *(n=6)*	7.5% *(n=3)*	5.0% *(n=2)*	0.0% *(n=0)*

Table 4.22 (*continued*) Percentage (number) of farmers & veterinarians in agreement with 15 statements pertaining to empathy and compassion towards sheep

	Profession	*Completely Agree* *1*	*2*	*3*	*4*	*5*	*Completely Disagree* *6*
It irritates me when pet lambs play around my feet	**Farmer (n=51)**	7.8% *(n=4)*	3.9% *(n=2)*	19.6% *(n=10)*	5.9% *(n=3)*	17.6% *(n=9)*	45.1% *(n=23)*
	Veterinarian (n=40)	0.0% *(n=0)*	0.0% *(n=0)*	10.0% *(n=4)*	10.0% *(n=4)*	25.0% *(n=10)*	55.0% *(n=22)*
Seeing healthy sheep nearly always puts me in a good mood	**Farmer (n=49)**	83.7% *(n=41)*	10.2% *(n=5)*	4.1% *(n=2)*	0.0% *(n=0)*	0.0% *(n=0)*	2.0% *(n=1)*
	Veterinarian (n=40)	65.0% *(n=26)*	25.0% *(n=10)*	10.0% *(n=4)*	0.0% *(n=0)*	0.0% *(n=0)*	0.0% *(n=0)*
It is silly to become emotionally attached to a sheep	**Farmer (n=50)**	8.0% *(n=4)*	14.0% *(n=7)*	20.0% *(n=10)*	16.0% *(n=8)*	24.0% *(n=12)*	18.0% *(n=9)*
	Veterinarian (n=40)	5.0% *(n=2)*	17.5% *(n=7)*	10.0% *(n=4)*	20.0% *(n=8)*	22.5% *(n=9)*	25.0% *(n=10)*
People often make too much of the feelings of sheep	**Farmer (n=50)**	4.0% *(n=2)*	4.0% *(n=2)*	26.0% *(n=14)*	20.0% *(n=10)*	18.0% *(n=9)*	28.0% *(n=14)*
	Veterinarian (n=40)	0.0% *(n=0)*	2.5% *(n=1)*	17.5% *(n=7)*	22.5% *(n=9)*	22.5% *(n=9)*	35.0% *(n=14)*
I enjoy patting or stroking pet lambs	**Farmer (n=50)**	28.0% *(n=14)*	18.0% *(n=9)*	18.0% *(n=9)*	12.0% *(n=6)*	14.0% *(n=7)*	10.0% *(n=5)*
	Veterinarian (n=40)	30.0% *(n=12)*	17.5% *(n=7)*	27.5% *(n=11)*	7.5% *(n=3)*	12.5% *(n=5)*	5.0% *(n=2)*

Table 4.23 (*continued*) Percentage (number) of farmers & veterinarians in agreement with 15 statements pertaining to empathy and compassion towards sheep

	Profession	*Completely Agree* *1*	*2*	*3*	*4*	*5*	*Completely Disagree* *6*
As a farmer/Vet I get great personal satisfaction from helping sheep in pain or distress	**Farmer (n=50)**	76.0% *(n=38)*	14.0% *(n=7)*	4.0% *(n=2)*	0.0% *(n=0)*	6.0% *(n=3)*	0.0% *(n=0)*
	Veterinarian (n=40)	82.5% *(n=33)*	12.5% *(n=5)*	5.0% *(n=2)*	0.0% *(n=0)*	0.0% *(n=0)*	0.0% *(n=0)*
When a sheep is in pain or distress I want to help it	**Farmer (n=51)**	88.2% *(n=45)*	11.8% *(n=6)*	0.0% *(n=0)*	0.0% *(n=0)*	0.0% *(n=0)*	0.0% *(n=0)*
	Veterinarian (n=40)	80.0% *(n=32)*	17.5% *(n=7)*	0.0% *(n=0)*	0.0% *(n=0)*	2.5% *(n=1)*	0.0% *(n=0)*
I don't like being around sheep when they are in pain	**Farmer (n=50)**	20.0% *(n=10)*	24.0% *(n=12)*	16.0% *(n=9)*	16.0% *(n=8)*	10.0% *(n=5)*	14.0% *(n=7)*
	Veterinarian (n=39)	7.7% *(n=3)*	7.7% *(n=3)*	35.9% *(n=14)*	20.5% *(n=8)*	12.8% *(n=5)*	15.4% *(n=6)*
I do all I can to reduce the amount of stress sheep experience from gathering or handling	**Farmer (n=51)**	70.6% *(n=36)*	23.5% *(n=12)*	5.9% *(n=3)*	0.0% *(n=0)*	0.0% *(n=0)*	0.0% *(n=0)*
	Veterinarian (n=40)	55.0% *(n=22)*	32.5% *(n=13)*	10.0% *(n=4)*	0.0% *(n=0)*	0.0% *(n=0)*	2.5% *(n=1)*
Trying to limit the fear sheep experience is a waste of time as they are naturally fearful.	**Farmer (n=51)**	2.0% *(n=1)*	2.0% *(n=1)*	7.8% *(n=4)*	5.9% *(n=3)*	21.6% *(n=11)*	60.8% *(n=31)*
	Veterinarian (n=40)	2.5% *(n=1)*	0.0% *(n=0)*	5.0% *(n=2)*	15.0% *(n=6)*	25.0% *(n=10)*	52.5% *(n=21)*

Table 4.24 Percentage (number) of farmers & veterinarians in agreement with 11 statements about attitudes towards pain and the use of pain relief in sheep

		Percentage (*number*)						
	Profession	**Completely agree 1**	**2**	**3**	**4**	**5**	**Completely disagree 6**	**Don't know 7**
Lame sheep benefit from pain relief as part of their treatment	**Farmer (*n*=51)**	35.3% (*n*=18)	25.5% (*n*=13)	9.8% (*n*=5)	3.9% (*n*=2)	0.0% (*n*=0)	0.0% (*n*=0)	25.5% (*n*=13)
	Veterinarian (*n*=38)	84.2% (*n*=32)	10.5% (*n*=4)	5.3% (*n*=2)	0.0% (*n*=0)	0.0% (*n*=0)	0.0% (*n*=0)	0.0% (*n*=0)
Including pain relief in the treatment of lame ewes improves their performance	**Farmer (*n*=51)**	37.3% (*n*=19)	23.5% (*n*=12)	7.8% (*n*=4)	2.0% (*n*=1)	0.0% (*n*=0)	0.0% (*n*=0)	29.4% (*n*=15)
	Veterinarian (*n*=38)	71.1% (*n*=27)	13.2% (*n*=5)	0.0% (*n*=0)	0.0% (*n*=0)	0.0% (*n*=0)	0.0% (*n*=0)	15.8% (*n*=6)
Including pain relief in the treatment of lame ewes improves their lamb's performance	**Farmer (*n*=51)**	25.5% (*n*=13)	21.6% (*n*=11)	3.9% (*n*=2)	3.9% (*n*=2)	0.0% (*n*=0)	0.0% (*n*=0)	45.1% (*n*=23)
	Veterinarian (*n*=38)	50.0% (*n*=19)	18.4% (*n*=7)	13.2% (*n*=5)	0.0% (*n*=0)	0.0% (*n*=0)	0.0% (*n*=0)	18.4% (*n*=7)
Including pain relief in the treatment of lame ewes improves their welfare	**Farmer (*n*=51)**	45.1% (*n*=24)	27.5% (*n*=14)	7.8% (*n*=4)	0.0% (*n*=0)	0.0% (*n*=0)	0.0% (*n*=0)	19.6% (*n*=10)
	Veterinarian (*n*=38)	89.5% (*n*=34)	7.9% (*n*=3)	0.0% (*n*=0)	0.0% (*n*=0)	0.0% (*n*=0)	0.0% (*n*=0)	2.6% (*n*=1)
Some degree of pain is beneficial to sheep	**Farmer (*n*=51)**	2.0% (*n*=1)	0.0% (*n*=0)	3.9% (*n*=2)	2.0% (*n*=1)	11.8% (*n*=6)	74.5% (*n*=39)	5.9% (*n*=3)
	Veterinarian (*n*=39)	0.0% (*n*=0)	5.1% (*n*=2)	5.1% (*n*=2)	5.1% (*n*=2)	10.3% (*n*=4)	74.4% (*n*=29)	0.0% (*n*=0)

Table 4.25 (*continued*) Percentage (number) of farmers & veterinarians in agreement with 11 statements about attitudes towards pain and the use of pain relief in sheep

Sheep experience pain in the same way as humans	**Farmer (*n*=50)**	14.0% (*n*=7)	22.0% (*n*=11)	12.0% (*n*=6)	6.0% (*n*=3)	6.0% (*n*=3)	4.0% (*n*=3)	36.0% (*n*=18)
	Veterinarian (*n*=39)	38.5% (*n*=15)	23.1% (*n*=9)	10.3% (*n*=4)	5.1% (*n*=2)	0.0% (*n*=0)	7.7% (*n*=3)	15.4% (*n*=6)
Treating the disease is the same as alleviating the pain	**Farmer (*n*=51)**	9.8% (*n*=5)	13.7% (*n*=7)	7.8% (*n*=4)	11.8% (*n*=6)	19.6% (*n*=10)	25.5% (*n*=13)	11.8% (*n*=6)
	Veterinarian (*n*=39)	5.1% (*n*=2)	2.6% (*n*=1)	23.1% (*n*=9)	20.5% (*n*=8)	20.5% (*n*=8)	28.2% (*n*=11)	0.0% (*n*=0)
It is difficult to recognise pain in sheep	**Farmer (*n*=51)**	7.8% (*n*=4)	15.7% (*n*=9)	11.8% (*n*=6)	9.8% (*n*=5)	23.5% (*n*=12)	25.5% (*n*=13)	5.9% (*n*=3)
	Veterinarian (*n*=37)	5.4% (*n*=2)	10.8% (*n*=4)	21.6% (*n*=8)	13.5% (*n*=5)	21.6% (*n*=8)	27.0% (*n*=10)	0.0% (*n*=0)
Pain relieving drugs are not necessary for lame sheep	**Farmer (*n*=51)**	0.0% (*n*=0)	0.0% (*n*=0)	5.9% (*n*=3)	13.7% (*n*=7)	21.6% (*n*=11)	31.4% (*n*=16)	27.5% (*n*=14)
	Veterinarian (*n*=38)	0.0% (*n*=0)	0.0% (*n*=0)	0.0% (*n*=0)	5.3% (*n*=2)	23.7% (*n*=9)	71.1% (*n*=27)	0.0% (*n*=0)
I think that pain relief should be part of the treatment of lame sheep	**Farmer (*n*=50)**	22.0% (*n*=11)	18.0% (*n*=9)	30.0% (*n*=15)	10.0% (*n*=5)	2.0% (*n*=1)	0.0% (*n*=0)	18.0% (*n*=9)
	Veterinarian (*n*=38)	68.4% (*n*=26)	26.3% (*n*=10)	2.6% (*n*=1)	2.6% (*n*=1)	0.0% (*n*=0)	0.0% (*n*=0)	0.0% (*n*=0)
If pain relieving drugs were cheaper I would use them when treating lame sheep	**Farmer (*n*=51)**	21.6% (*n*=11)	21.6% (*n*=11)	13.7% (*n*=7)	5.9% (*n*=3)	7.8% (*n*=4)	9.8% (*n*=5)	19.6% (*n*=10)
In general farmers would use pain relieving drugs more often when treating lame sheep if they were cheaper	**Veterinarian (*n*=39)**	35.9% (*n*=14)	30.8% (*n*=12)	23.1% (*n*=9)	7.7% (*n*=3)	2.6% (*n*=1)	0.0% (*n*=0)	0.0% (*n*=0)

Table 4.26 Percentage (number) of farmers & veterinarians in agreement with statements pertaining to the farmer/vet relationship

	Percentage (*number*)						
	Completely Agree **1**	**2**	**3**	**4**	**5**	*Completely Disagree* **6**	*Don't Know* **7**
Farmers							
I would feel comfortable asking my vet for pain relieving drugs for lame sheep	59.2 (*n=29*)	16.3 (*n=8*)	4.1 (*n=2*)	2.0 (*n=1*)	4.1 (*n=2*)	6.1 (*n=3*)	8.2 (*n=4*)
My vet has discussed with me the use of pain relieving drugs for lame sheep	32.7 (*n=16*)	8.2 (*n=4*)	4.1 (*n=2*)	2.0 (*n=1*)	6.1 (*n=3*)	40.8 (*n=20*)	6.1 (*n=3*)
My vet won't prescribe pain relieving drugs for lames sheep	2.0 (*n=1*)	0.0 (*n=0*)	0.0 (*n=0*)	6.1 (*n=3*)	2.0 (*n=1*)	51.0 (*n=25*)	38.3 (*n=19*)
My vet doesn't think pain relieving drugs are necessary for lame sheep	0.0 (*n=0*)	2.0 (*n=1*)	4.1 (*n=2*)	4.1 (*n=2*)	4.1 (*n=2*)	34.7 (*n=17*)	51.0 (*n=25*)
Veterinarians							
I would feel comfortable discussing with farmers the use of pain relieving drugs as part of the treatment of lame sheep	72.5 (*n=29*)	15.0 (*n=6*)	2.5 (*n=1*)	0.0 (*n=0*)	2.5 (*n=1*)	5.0 (*n=2*)	0.0 (*n=0*)
In general farmers won't use pain relieving drugs when treating lame sheep	12.5 (*n=5*)	42.5 (*n=17*)	12.5 (*n=5*)	17.5 (*n=7*)	12.5 (*n=5*)	0.0 (*n=0*)	0.0 (*n=0*)
In general farmers don't think pain relieving drugs are necessary for lame sheep	10.0 (*n=4*)	42.5 (*n=17*)	20.0 (*n=8*)	7.5 (*n=3*)	12.5 (*n=5*)	5.0 (*n=2*)	0 (*n=0*)

Table 4.27 Percentage (number) of farmers & veterinarians in agreement with 3 statements about the social/subjective norms of using pain relief as part of the treatment of lameness in sheep

Social Norms		Percentage					
		Highly Approve					*Highly Disapprove*
		1	***2***	***3***	***4***	***5***	***6***
How much would other farmers/vets approve of you giving pain relieving drugs to lame sheep	**Farmer *(n=49)***	12.0 *(n=6)*	24.5 *(n=13)*	36.7 *(n=18)*	18.4 *(n=9)*	4.1 *(n=2)*	4.1 *(n=2)*
	Veterinarian *(n=39)*	59.0 *(n=23)*	38.5 *(n=15)*	2.6 *(n=1)*	0.0 *(n=0)*	0.0 *(n=0)*	0.0 *(n=0)*
How much would your vet/farmers approve of you giving pain relieving drugs to lame sheep	**Farmer *(n=49)***	40.8 *(n=20)*	26.5 *(n=13)*	20.4 *(n=10)*	10.2 *(n=5)*	0.0 *(n=0)*	2.0 *(n=1)*
	Veterinarian *(n=39)*	5.1 *(n=2)*	56.4 *(n=22)*	33.3 *(n=13)*	2.6 *(n=1)*	2.6 *(n=1)*	0.0 *(n=0)*
How much would your family approve of you giving pain relieving drugs to lame sheep	**Farmer *(n=49)***	46.0 *(n=23)*	18.0 *(n=9)*	24.5 *(n=12)*	8.2 *(n=4)*	2.0 *(n=1)*	0.0 *(n=0)*
	Veterinarian *(n=38)*	81.6 *(n=31)*	13.2 *(n=5)*	5.3 *(n=2)*	0.0 *(n=0)*	0.0 *(n=0)*	0.0 *(n=0)*

Table 4.28 Percentage (number) of farmers & veterinarians in agreement with 3 statements about their level of self-efficacy/perceived behaviour control towards the use of pain relief in the treatment of sheep lameness

		Percentage (number)					
		Total Control					***No Control***
		1	***2***	***3***	***4***	***5***	***6***
How much personal control do you have over whether lame sheep on your farm/your client's farm(s) receive pain relieving drugs as part of their treatment?	**Farmers** ***(n=51)***	82.4 *(n=42)*	11.8 *(n=6)*	0.0 *(n=0)*	3.9 *(n=2)*	2.0 *(n=1)*	0.0 *(n=0)*
	Vets ***(n=38)***	0.0 *(n=0)*	23.7 *(n=9)*	42.1 *(n=16)*	15.8 *(n=6)*	15.8 *(n=6)*	2.6 *(n=1)*
		Very Confident					***Not at all Confident***
		1	***2***	***3***	***4***	***5***	***6***
How confident are you that you can provide pain relieving drugs as part of the treatment of lame sheep on your farm/your client's farms?	**Farmers** ***(n=51)***	54.9 *(n=28)*	21.6 *(n=11)*	9.8 *(n=5)*	2.0 *(n=1)*	2.0 *(n=1)*	9.8 *(n=5)*
	Vets ***(n=38)***	28.9 *(n=11)*	44.7 *(n=17)*	7.9 *(n=3)*	5.3 *(n=2)*	10.5 *(n=4)*	2.56 *(n=1)*
		Very Likely					***Not at all Likely***
		1	***2***	***3***	***4***	***5***	***6***
How likely is it that you will provide pain relieving drugs as part of the treatment of lame sheep on your farm/your client's farms over the next 12 months?	**Farmers** ***(n=50)***	32.0 *(n=16)*	24.0 *(n=12)*	22.0 *(n=11)*	4.0 *(n=2)*	4.0 *(n=2)*	14.0 *(n=7)*
	Vets ***(n=38)***	50.0 *(n=19)*	31.6 *(n=12)*	13.2 *(n=5)*	2.6 *(n=1)*	0.0 *(n=0)*	2.6 *(n=1)*

9.1 Relationship between attitudes, empathy and pain rating

A high factor regression score indicates: a stronger belief in the benefits of analgesic use, greater affective empathy, less judgemental of others or greater compassion. No correlations were found between participants' factor scores and how they rated pain on the VAS (r<0.083; p<0.05). Significant positive correlations were found between: compassion and benefits; affective empathy and judgement; judgement and compassion Table 4.29.

Table 4.29 Spearman Rank correlations (*r*) between the benefits of analgesic use, affective empathy, judgement, and compassion factor scores and pain

Factor Scores	Benefits		Affective Empathy		Judgement		Compassion	
	r	***p***	***r***	***p***	***r***	***p***	***r***	***p***
Affective Empathy	0.223	0.112						
Judgement	-0.015	0.917	0.247	0.020				
Compassion	0.344	0.011	0.529	0.999	0.341	0.001		

The Kaiser-Meyer-Olkin measure of sampling adequacy indicated that the variables in the attitudes and empathy and compassion scales had adequate commonalities to warrant component analysis (attitudes: 0.735, empathy & compassion: 0.547). Bartlett's test of sphericity showed that there were adequate correlations between the variables to allow for component reduction (attitudes: Chi-Sq: 291.4; df: 45, p<0.000, empathy & compassion: Chi-Sq: 289.7; df: 105, p<0.000).

9.2 Effects of profession, age and gender on attitudes, empathy and pain rating

Farmers were more compassionate than vets (p=0.006); females were more compassionate (p=0.002) and less judgemental of others than males (p=0.002) and veterinarians and females agreed more with the benefits of analgesic use than farmers (p=0.016) and males (p=0.038) respectively (Table 4.26) and (Table 4.27).

Table 4.30 Effects of profession, gender and age on 'benefits', 'affective empathy', 'judgement of others', 'compassion' and 'pain'

Variable *Factor*	**Wald**	**f**	**df**	***p***
Benefits				
Profession	6.35	6.35	41.0	0.016
Gender	4.60	4.60	41.0	0.038
Age	0.01	0.01	41.0	0.909
Judgement of others				
Profession	0.10	0.10	73.0	0.749
Gender	10.75	10.75	73.0	0.002
Age	0.99	0.99	73.0	0.324
Compassion				
Profession	8.15	8.15	74.0	0.006
Gender	10.51	10.51	74.0	0.002
Age	1.74	1.74	74.0	0.191
Affective empathy				
Profession	3.20	3.20	72.0	0.078
Gender	3.88	3.88	72.0	0.053
Age	2.69	2.69	72.0	0.105
Pain				
Profession	0.52	0.52	70.0	0.474
Gender	0.36	0.36	70.0	0.549
Age	1.77	1.77	70.0	0.187

Table 4.31 Mean (s.e.) scores of farmers, vets, females and males for ‘benefits’, ‘judgement of others’, ‘compassion’ and ‘affective empathy’

Factor	Benefits	Judgement of others	Compassion	Affective empathy	Pain VAS
Farmers	-0.26 (0.17)	0.05 (0.16)	0.27 (0.15)	0.18 (0.16)	69.7 (2.09)
Vets	0.33 (0.15)	-0.03 (0.18)	-0.44 (0.18)	-0.28 (0.18)	72.1 (2.34)
Females	0.28 (0.15)	0.41 (0.16)	0.30 (0.16)	0.19 (0.16)	71.9 (2.13)
Males	-0.22 (0.17)	-0.39 (0.17)	-0.47 (0.17)	-0.29 (0.17)	69.9 (2.12)

9.3 Relationship between the decision to treat the lame sheep with analgesia and attitudes, empathy and pain rating

Based on the video clip and the photograph of the lame sheep participants who answered ‘yes’ to ‘give an anti-inflammatory/pain relieving drug’ scored higher on the ‘benefits’ (p=0.007) scale but no relationship was found for any of the three empathy scales or the pain rating (Table 4.32).

Table 4.32 Participants' decision on whether to give pain relief to the lame sheep and their 'benefits', 'affective empathy', 'judgement of others' 'compassion' and pain scores

	Response	median	rank	H	*p*
Benefits (*n*=54)				10.01	0.007
	Yes (*n*=32)	0.69	32.8		
	Maybe (*n*=12)	-0.36	18.8		
	No (*n*=10)	-0.08	20.9		
Judgement (*n*=87)				1.13	0.568
	Yes (*n*=37)	0.17	43.8		
	Maybe (*n*=23)	-0.07	40.0		
	No (*n*=27)	0.45	47.6		
Compassion (*n*=88)				2.34	0.311
	Yes (*n*=36)	0.44	43.1		
	Maybe (*n*=23)	0.23	40.1		
	No (*n*=26)	0.64	50.0		
Affective empathy (*n*=86)				0.18	0.914
	Yes (*n*=36)	0.31	43.3		
	Maybe (*n*=23)	0.39	45.2		
	No (*n*=27)	0.39	42.4		
Pain (*n*=85)				4.32	0.115
	Yes (*n*=36)	74	49.3		
	Maybe (*n*=23)	69	36.5		
	No (*n*=26)	71	40.0		

9.4 Relationship between the frequency of analgesia use as part of lameness management and attitudes and empathy

Participants were asked how frequently they had used analgesia as part of the treatment of lameness on their farms (farmers) or when treating clients sheep (vets), over the previous twelve months. A significant positive correlation was found between 'benefits' and frequency (r=0.356, *p*=0.009), a significant negative correlation was found between compassion and frequency (r=-0.228, *p*=0.032) and no significant correlations was found between judgement (r=-0.127, *p*=0.239) or affective empathy (r=-0.183, *p*=0.090) and frequency.

9.5 Relationship between standard use of analgesia as part of lameness management and self –efficacy and social norms

No relationship was found between the frequency of analgesic use as part of lameness management and participants' rating of their own self-efficacy and how much they thought others would approve of this behaviour (social norms) (Table 4.29). This is with the exception of vets who frequently recommended using analgesia as part of lameness management being more likely to use analgesia in the future.

Table 4.33 Spearman Rank Correlation (*r*) between participants' levels of self-efficacy, their perceptions of social norms and the frequency with which participants' used analgesia as part of the treatment of lame sheep on their/their client's farm(s)

Self-efficacy		***r***	***p***
Personal control over analgesic provision	Farmers	0.109	0.462
	Vets	-0.000	0.999
Confident in ability to provide analgesia	Farmers	-0.179	0.223
	Vets	0.083	0.620
Likely to administer analgesia in the coming 12 months	Farmers	0.126	0.400
	Vets	0.402	0.012
Social norms			
Farmer approval of analgesic provision	Farmers	0.231	0.118
	Vets	0.211	0.197
Vet approval of analgesic provision	Farmers	0.131	0.379
	Vets	0.196	0.233
Family approval of analgesic provision	Farmers	0.262	0.075
	Vets	-0.084	0.618

10. Discussion

10.1 Summary of findings

The aims of this study were to develop novel multi-item rating scales for the assessment of attitudes and empathy towards lameness and pain in sheep, and to subsequently investigate the relationship with analgesic provision. A good degree of success was achieved with the development of novel multi-item rating scales, and a significant effect of participants' attitudes to the benefits of analgesic use on analgesic use was found. The reported use of analgesia for lameness both on farm and for the lame sheep from the video was more likely if the participant had more positive attitudes to the benefits of analgesic use. However no relationship between analgesia provision and any of the empathy scales or pain ratings were found.

10.2 Relationship between attitudes, empathy and pain rating

A positive relationship was found between all three of the empathy sub-scales with the strongest relationship being between affective empathy and compassion. This suggests that those individuals who are more emotionally responsive in their dealings with sheep are also more motivated to alleviate or prevent pain or distress. However, surprisingly no relationship was found between participants' compassion scores and their decision to give analgesia to the sheep from the video, and a negative correlation was found between compassion and the frequency with which participants said they used analgesia on farm. There are a number of potential explanations for this finding. The compassion scale may not be measuring compassion, and may instead be measuring a different psychological construct. It is also possible that the very low use of analgesia by farmers makes the investigation of a relationship with other factors difficult. Also it is worth noting that the correlation between compassion and frequency of analgesic use is weak.

10.3 Pain

No correlations were found between the severity of pain participants perceived the sheep in the video to be experiencing, and participants' attitudes, empathy and compassion scores. These results support what Muri et al. (2012) found in their study on goat farmer empathy, where no relationship was found between empathy and the ratings of painful conditions. In contrast to studies that found that a relationship between pain perception and analgesic provision (Susan E Dohoo and Dohoo, 1996; Hewson et al., 2007b; Huxley and Whay, 2006) participants who rated the pain most highly were no more likely to provide an analgesic than those who rated the pain as less severe. The decision of whether to provide analgesics was very evenly spread across all three ('yes', 'maybe', 'no') answers and perhaps the lack of relationship found is as a result of the low frequency of analgesia use, and the current lack of consensus on the use of analgesics, as part of the treatment of lame sheep. This is evidenced by the difference between farmers (21%) and vets (65%) who completely agreed with the statement '*I think that pain relief should be part of the treatment of lame sheep*'. This is further supported by a study of UK sheep management practices that found that two-thirds of the farmers surveyed never provided analgesia for lame ewes (Rutherford et al. *in prep*).

10.4 Attitudes

A number of the attitude items used were taken from the literature and adapted, for example '*lame sheep benefit from pain relief as part of their treatment*'. This item was adapted from a number of cattle studies that asked farmers and vets whether they agreed that pain relief was beneficial to cattle, with the large majority agreeing: 98% of UK vets (Whay and Huxley, 2005), 100% of Finnish vets, (Raekallio et al., 2003), 94 and 99% of Danish farmers and vets respectively (Thomsen et al., 2012), and 96% of Scandinavian vets (Thomsen et al., 2010). The results from this study were slightly lower with 95% of vets and only 61% of farmers agreeing that '*lame sheep benefit from pain relief as part of their treatment*'. It's important to note that in the cattle studies the item referred to pain in general, whereas here it specifically addresses pain caused by lameness.

Twenty-six percent of farmers answered that they did not know if lame sheep benefited from pain relief. This raises the point that vets could be doing more to communicate the benefits to farmers. When asked whether their vet had discussed with them the use of analgesia for lame sheep only 41% of farmers agreed. In fact 53% of vets agreed that '*in general farmers don't think pain relieving drugs are necessary for lame sheep.* However no farmers agreed with the statement '*pain relieving drugs are not necessary for lame sheep'.*

Perhaps surprisingly, only 61% of farmers agreed that pain relief was beneficial, whilst 73% agreed that '*including pain relief in the treatment of lame ewes improves their welfare*'. On average 86% of vets agreed with the four statements pertaining to the various benefits of analgesia compared to 60% of farmers. A number of vets also said they 'didn't know' to some of these items, for example 18% for '*including pain relief in the treatment of lame ewes improves their lamb's performance*'. This highlights the importance of knowledge transfer from researcher to practitioner. Although the benefits of analgesic provision to lame sheep are largely unknown with only one study investigating recovery time (Kaler et al., 2010) it is likely that at the very least welfare will improve as a result of lowered pain levels. In addition, this will encourage feeding, which will help the sheep maintain condition better and in the case of lactating ewes will produce better quality milk. Lame sheep are likely to spend less time on their feet and therefore less time exposing their udder to their lambs and lameness has been shown to increase the incidence of barren ewes (Wassink et al., 2010).

In contrast to the cattle studies, only 2% of farmers and 5% of vets agreed that some degree of pain is beneficial in comparison with up to 43% of Swiss farmers (Becker et al., 2013), 35% of Finnish vets (Raekallio et al., 2003) and 10 and 16% of Danish farmers and vets respectively (Thomsen et al., 2012). Anecdotal evidence from speaking to farmers at agricultural shows indicates that there is a belief held by some farmers that treating the infection is the same as treating the pain. This study found that only 40% of farmers and 47% of vets disagreed with the statement 'treating the disease is the same as alleviating the pain'.

10.5 Empathy

The aim of the development process of the empathy scale was to include items that covered three separate aspects of empathy (cognitive, affective and compassionate) using the previous work (Muri et al., 2012) on empathy towards goats as a guide. However a number of the items get at slightly different factors than intended, such as participants' perceptions of how others feel about sheep, rather than of their own perceptions of the mental and affective experiences of sheep.

Affective empathy is concerned with responding appropriately to another's emotions. It is proposed here that the items in the scale labelled affective empathy address this by assessing emotional responses to two situations in which sheep are harmed or unwell and two where they are healthy or being helped back to health. In contrast Muri and colleagues interpret similar items as 'personal distress', a negative emotional response associated with the inability to regulate one's emotions, and highlight research that suggests that this form of emotional response is less likely to lead to helping behaviour (Eisenberg and Eggum, 2009). However, I argue here that these items in the affective empathy scale better reflect appropriate emotional responses over non-functional personal distress.

The items in the empathy sub-scale 'judgement of others' are similar to those from the perspective taking sub-scale from the goat study. Muri and colleagues (2012) labelled this subscale 'perspective taking' arguing that the items correspond to the sub-scale of the same name from the interpersonal reactivity index (IRI) subscale designed to assess human-orientated empathy (Davis, 1980). However the IRI perspective taking sub-scale contains items pertaining to seeing a situation from another's perspective such as, '*when I'm upset at someone, I usually try to "put myself in his shoes" for a while*'. However, here is it proposed that these items, both in this study and in the goat study pertain more to the judgement of others feelings, for example '*it is silly to become emotionally attached to a sheep*'/'*it is silly to become attached to a goat*'.

A significant effect of gender was found with females being less judgemental and more compassionate than males. There was also a trend for females having greater affective empathy than males. These findings may support those of other studies. For example Serpell (2005) found that gender was the most significant predictor of humane attitudes to animals, with female vet students having more positive attitudes than males. In addition female vet students were shown to maintain their level of affective empathy over the duration of their studies, whereas males showed lower levels of empathy in later years (Paul and Podberscek, 2000). Whilst other studies have found that females showed greater concern for the welfare of animals than did males (Herzog et al., 1990; Taylor and Signal, 2005).

11. Conclusion

More empathetic individuals were found to be no more likely to use analgesia as part of lameness management than less empathetic individuals, and surprisingly a negative correlation between compassion and analgesic use was found. Similarly no consistent effect of self-efficacy or social norms on analgesic provision was found. However an effect of attitudes to analgesic benefits was found with those who held more positive attitudes being more likely to use analgesia. In light of the finding that farmers had significantly less positive attitudes to analgesic use than vets, this may have implications for lameness management on farm. This is further highlighted by the finding that almost half the farmers said their vet had never discussed the use of analgesia as part of lameness management with them, and that over half of the vets believed that farmers did not think analgesia was necessary for lame sheep. Around a quarter of farmers answered that they did not know what the benefits of analgesic use were and did not know whether they were a necessary part of lameness management. These findings highlight the need for greater communication between farmers and their vets around the issue of pain and pain management.

12. General discussion

No effect of gender was found on how pain was rated. There have been a number of studies investigating how farmers, vets and vet students rate pain, and results on gender differences are varied. Kielland et al (2010) and Muri et al (2012) who looked at farmers' ratings of pain in cattle and goats respectively did not find an effect of gender. Two studies on cattle vets (Huxley and Whay, 2006; Laven et al. 2009) did find a gender difference with females scoring pain more highly. In addition a study of pig farmers and vets found that females scored pain more highly for farrowing and shoulder sores (Ison and Rutherford, 2014). The results from study two did find an effect of gender but this disappeared when profession was included in the analysis.

It is possible that the profession differences seen between farmers and vets in how they scored the two moderate/severely lame sheep in study one was due to a gender or age effect, however the lack of complete demographic data prohibited investigation of this. However no effect of gender or age on the scoring of pain was found in study two. In fact there appeared to be a greater amount of general agreement of how pain was scored in study two. This could be explained in a number of ways. Firstly, the sample size was smaller in the second study, reducing the chance of finding a significant difference. Secondly, the studies differed in how participants were recruited. It is likely that study one contained a more representative sample as recruitment was conducted at a variety of events where participants were approached and actively encouraged to take part. This form of recruitment is likely to be more successful than the indirect approach used in study two. It is possible that a degree of selection bias occurred for study two whereby those who participated had an interest in or strong views on the subject area and as such are less representative of the population as a whole.

The investigation of more affective components of lameness and pain had varied results. In study one there was a clear relationship between the scoring of lameness, pain and emotional reaction indicating an affective element to diagnosis. In addition the greatest differences were seen for emotional reaction with vets scoring their emotional reaction significantly higher than farmers. However in study two farmers scored significantly higher than vets for affective empathy, and although not statistically different they also scored higher on compassion and judgement.

Overall it is clear that lameness is perceived to be a painful condition and that there is a desire to alleviate this pain. However the highly significant difference between farmers and vets in how they perceived the benefits of analgesics is of importance and demonstrates a need to better communicate with farmers about analgesic use as part of the treatment of lame sheep.

13. General conclusion

The importance of empathy towards pain perception and motivation to use analgesia as part of lameness management is unclear. These results suggest a lack of relationship. However it is possible these novel empathy scales were measuring a psychological construct similar to, but different from, empathy. It is also possible that analgesic use for lameness management is so uncommon that it is difficult to assess the relationship between its use and an individuals' empathetic tendency. Farmers' and vets' beliefs in the capacity of livestock to experience affective states such as pain is likely to impact upon how they handle and manage these animals, therefore gaining a better understanding of these views and how they may impact upon welfare is of importance.

Chapter 5 General discussion & conclusion

1. Introduction

This thesis aimed to investigate the views of those responsible for the care of farmed animals: farmers, veterinarians and students (agriculture and veterinary). The primary focus of this thesis was to assess views on pain and the use of pain relief in sheep. Similar studies investigating attitudes towards pain in animals have been conducted. However, these studies have for the most part focused on cattle and small animal vets, with only a small number investigating the attitudes of farmers. This imbalance warrants addressing as, although vets play an important role in the health and welfare of their clients' animals it is the farmer that is solely responsible for the daily care of his/her animals. Therefore a farmer's ability to accurately recognise and manage pain in his/her animals will be paramount for good animal welfare.

This thesis is the first body of work that has aimed to understand the attitudes of sheep farmers and vets towards pain in sheep. In addition, investigating the views of cattle farmers has enabled, for the first time a direct comparison of these two farmer groups. Between them, they are responsible for the health and welfare of over 32 million cattle and sheep UK wide (DEFRA, 2014).

A wealth of research now exists on human-animal relationships, including farm animals, clearly showing the importance of personality, and positive behaviour and attitudes of stockpersons for good animal welfare (Rushen and de Passillé, 2015). The attitudes of individuals towards pain and analgesic use in animals are likely to dictate how pain is subsequently managed. This thesis combined four separate questionnaire studies designed to gather information from those responsible for the care of livestock. They covered:

i) perceptions of the pain associated with a number of common procedures and conditions (cattle and sheep).

ii) views on pain management in relation to other welfare requirements.

iii) perceptions of the capacity of different animal species to experience pain.

iv) perceptions of the pain severity associated with lameness in sheep.

And finally, I aimed to investigate the potential role that empathy and compassion towards sheep play in lameness treatment decisions.

Results from all four studies indicate that overall, positive attitudes are held by farmers, vets and students. Significant effects of gender, age, experience and participant group (profession, or course of study for students) were found, suggesting that these factors shape individuals' perceptions of pain in animals. This is likely to have implications for the welfare of animals.

2. Methodology

The aim of this thesis – to assess the views of sheep farmers and vets to pain and welfare in sheep – is novel. Similarly, a number of novel methods and novel applications of existing methods were utilised in the collection of data.

The novelty of the farmer questionnaire detailed in chapter two lies in its assessment of sheep famers': i) perceptions of how painful a number of common conditions and procedures are for sheep, ii) views on pain management in livestock, iii) views on the relative importance of different aspects of good welfare using a novel adaptation of the Five Freedoms framework, iv) perceptions of sentience in different species. In addition, the farmer questionnaire was highly successful in terms of the number of farmers who participated, with a substantially greater sample size than other farmer surveys on pain in livestock (Ison and Rutherford, 2014; Kielland et al., 2010; Muri and Valle, 2012; Thomsen et al., 2012; Wikman et al., 2013).

To my knowledge the student questionnaire is the largest of its kind both in terms of the number of participants (over 2,500), but also in regard to the number of institutions involved (17), and in the breadth of courses that students were studying. In addition it is the first questionnaire to assess the views of both agriculture and veterinary students, thus allowing for comparisons to be made between these two groups. It is also unique in that its focus was on attitudes to pain and welfare in farm animals. Moreover, although other studies have assessed students' views on animal sentience, primarily with the use of scales asked to rate the capacity of different animal species to experience a range of emotions, this is the first time the belief in animal mind scale (Hills, 1995) has been used on a student population.

Chapter four details two studies in which participants use visual analogue scales to record their perceptions of lameness and pain in sheep. Visual analogue scales have been used previously as a method of scoring lameness severity in sheep (Welsh et al., 1993), but they have not been utilised as a method for assessing pain in sheep. To my knowledge, no study has investigated people's emotional reaction to lameness or pain in animals.

Some of the methods used within this thesis adapted pre-existing items from the literature. For example half of the statements utilised in the farmer and student questionnaire (**chapters two and four** respectively) were adapted from a number of studies investigating the attitudes of farmers and vets to pain in cattle (Raekallio et al., 2003; Thomsen et al., 2012, 2010; Whay and Huxley, 2005). In addition, many of the attitudinal, empathy and compassion statements used in the lameness and empathy study (**chapter four** – study two) were based on items that had been used in other research (Fehr and Sprecher, 2009; Ison and Rutherford, 2014; Kielland et al., 2010; Muri and Valle, 2012; Paul, 2000; Pommier, 2010; Raekallio et al., 2003; Thomsen et al., 2012, 2010; Whay and Huxley, 2005). The remaining items were specifically developed for this research. The developmental stage involved consultation with a number of animal welfare scientists, veterinarians and farmers to ensure the final items were clear and relevant. The subsequent application of principal component analyses and regression factor score generation on these items, enabled the combined information contained within responses to individual statements to be condensed down into a single value for each participant. This allowed for a more concise investigation of the relationship between participants' views and other variables of interest. This application of principal component analysis had been used successfully in a similar study of goat farmers (Muri and Valle, 2012). The additional use of reliability analyses, in the form of Cronbach's alpha, indicated acceptable levels of reliability in these scales. These methods have resulted in the development of novel scales for use in sheep farmers and vets, whose views up till now have remained largely unexamined. These novel scales, which include, 'attitudes to pain in livestock', 'benefits of analgesic use', 'empathy', 'judgement of others', and 'compassion' can be used in future studies interested in understanding farmers' and vets' views. Additionally, there is scope to adapt them or apply them to different populations of interest which may include farmers and vet of other livestock species, such as pigs or goats, or farmers and vets in other countries.

The novelty of this thesis can be seen in three areas. The first of these concerns the focal species, sheep. Sheep have been underrepresented in the literature on human-animal relationships. The second is the investigation of attitudes towards welfare and pain in sheep and the development and use of empathy and compassion scales. The third area is the focus on sheep farmers and vets, as well as agriculture and veterinary students. A number of the methodologies used within this thesis have rarely or never been applied to these study populations. Overall this thesis has provided new and novel data that have furthered our understanding of perspectives on farm animal welfare and pain.

3. Differences between farmers, vets and students in their attitudes and empathy

Overall, across all four studies and all participant groups attitudes to pain in animals were positive. The vast majority of farmers, vets and students recognised livestock as sentient beings capable of experiencing pain. It was generally accepted that pain is a negative experience for animals and that pain alleviation is beneficial.

A small number of attitudinal statements were utilised in multiple studies, thus allowing for comparisons between study populations to be made. For example of the farmers and vets that took part in the lameness and empathy study (**chapter 4** – study two) 2 and 5% respectively agreed that '*some degree of pain is beneficial to sheep*', in comparison to the 9% of sheep farmers that took part in the farmer questionnaire (**chapter 2**), and the respective 8 and 9% of agriculture and veterinary students from the student questionnaire (**chapter 3**) who agreed with the same statement. Although the percentage difference between the two sheep farmer groups from chapter 2 and 4 is small, it may highlight potential differences in the study populations.

A substantial difference between famers (**chapter 2**) and students (**chapter 3**) was found in the level of agreement reported for the statement '*farm animals benefit from pain alleviation*'. The vast majority (95%) of farmers agreed with this statement, and a similar level of agreement (94%) was seen in veterinary students. However, only 66% of agriculture students agreed with the same statement. This difference in attitude may have implications for animal welfare if it perpetuates into the careers of those students who enter the farming profession. Other areas where agriculture students differ from farmers in their responses was in their self-reported emotional reaction to the videos of sheep (**chapter 4** – study one). For all four videos, agriculture students reported a significantly lower emotional response than did farmers. These differences highlight disparities between farmers and agriculture students in their attitudes and responses towards lameness and pain in sheep. A possible explanation for these observed differences is that a number of students may be specialising in arable farming and as such have a lesser knowledge of animal production and welfare, in particular lameness in sheep, which could result in attitudinal differences between individuals. It is unknown whether agriculture students' attitudes will perpetuate through into their careers, as in reality, their views may change and become more in line with those of current farmers. However, these differences may warrant further study to assess more fully the potential that attitudinal differences do exist between farmers and agriculture students. Understanding the various stages and factors that influence attitude formation, will better enable education providers to tailor their courses to ensure that students leave education with positive views about animals and animal welfare.

Differences between agriculture and veterinary students were seen in a number of areas. Vet students had higher scores on the '*attitudes to pain in livestock*' (APL) and '*belief in animal mind*' (BAM) scales and scored the pain capacity of all eight species higher than did agriculture students. The only area where no difference was found was in how these two student groups scored the Freedoms. The differences that were seen may be attributable to the difference in focus between agricultural and veterinary education. Agriculture students will study a variety of components of farming, for example horticulture, and some individuals will therefore have a less animal focused education than vets. Vet students will also have a greater focus on animal anatomy and physiology, including the physiology of pain and the pharmacology and efficacy of pain medications. In addition veterinary students will be studying for longer, in some cases twice as long. Some veterinary courses are six years (e.g. Cambridge), or students may take a preliminary year, as offered at some universities (e.g. RVC). This is in comparison to the three or four year degree taken by agriculture students. This extended period of time in education for veterinary students compared to agriculture students is likely to have an impact upon the views held by these students. A comparison of APL and BAM across years of study did in fact reveal that vet students in year's three to six had more positive attitudes than did students in years one and two. However, this is contrary to findings of another study where vet students in later years of study rated animals as having lower levels of sentience than students in earlier years (Paul and Podberscek, 2000).

Additionally, differences between participant groups were found in the study of lameness and pain perception (**chapter 4** – study 1). Although there was overall agreement between participant groups to catch the two moderate/severely lame sheep for inspection, only 27 and 48% of agriculture and veterinary students respectively said they would catch and inspect the mildly lame sheep, compared to 61 and 74% of farmers and vets respectively. Agriculture students also had the lowest emotional reaction scores for the two moderate/severely lame sheep.

The farmer questionnaire (**chapter two**) enabled a comparison of cattle and sheep farmers in their attitudes towards pain in livestock. Analysis of the APL scale found that cattle farmers scored more highly than did sheep farmers. Upon inspection of responses to the individual statements that made up the scale, the greatest differences between cattle and sheep farmers were for statements relating to management practices and the costs associated with analgesic provision.

Almost twice as many (14% versus 8%) sheep farmers agreed that '*providing pain relief is impractical most of the time as a result of the need for increased time and labour*' and that '*difficulties with gathering and/or handling means that is it difficult to administer pain relief*', (17% versus 9%), indicating that sheep farmers find the limitations of time and labour a greater constraint than do cattle farmers. This is unsurprising in light of the fact that sheep farms are likely to be more extensive i.e. sheep farmers have less day to day contact with their animals than cattle farmers. These results suggest that limitations of management are greater barriers for sheep farmers than for cattle farmers. There may also be a relationship difference between how cattle farmers view their cattle and how sheep farmers view their sheep. With the greater degree of human-animal interaction that is likely to occur in cattle farming facilitating the development of a more positive association between farmer and animal.

4. Time has the power to change attitudes for better and for worse?

This research consisted of cross-sectional studies as opposed to longitudinal studies; as such it is not possible to know whether the observed differences between age groups and differing levels of experience were as a result of changing views or whether some other elements such as a cohort effect, were responsible for these differences. However, it is possible that students' attitudes towards animal sentience and welfare improve as they move through their education. At the same time the effect of experience on farmers' attitudes is just as plausibly a result of individual farmers becoming less positive in their attitudes over time, as is the existence of farmer cohorts with different views. The fact that the attitudes of students may improve with age does not mean that the opposite cannot happen with farmers. As age and experience are positively correlated it is not possible to know whether the differences seen between experienced and inexperienced farmers are as the result of individual's attitudes changing with age, or the result of a cohort effect where more experienced farmers hold different views from less experienced farmers. This cohort effect has been noted within the veterinary profession with more recent graduates showing more positive attitudes to pain and welfare (Capner et al., 1999; Huxley and Whay, 2006; Laven et al., 2009). It is possible that attitudinal differences seen within the veterinary profession also exist within the farming profession, with older or more experienced farmers having less positive attitudes to welfare. This could explain the lower Freedom scores assigned by more experienced farmers.

Although no effect of experience was found on farmers' APL, more experienced farmers rated the importance of the Freedoms lower (with the exception of 'prompt treatment' and 'pain relief') and they also scored all four species lower in their capacity to feel pain (**chapter two**). In addition, more experienced farmers rated the pain associated with a number of conditions and procedures (including difficult lambing, and castration and caesarean section in cattle) lower. Furthermore the effect of experience interacted with the effect of 'attitude group' for sheep farmers' perception of the pain caused by castration, tail docking and the combined pain scores for all conditions and procedures. Specifically, experienced farmers with the most positive attitudes towards pain and analgesic use rated the pain associated with castration and tail docking lower than less experienced farmers with the most positive attitudes. Research studies have shown that castration and tail docking are acutely painful for lambs, with negative implications for their welfare (Graham et al., 1997; Kent et al., 2000, 1998; Molony et al., 2012, 2002). The Code of Recommendation for the Welfare of Livestock (DEFRA, 2002), FAWC (FAWC, 2008), and farm assurance schemes such as 'RSPCA Assured' (previously Freedom Foods) (RSPCA, 2013) all state that these procedures should only be carried out when there is a definite need, and should not be considered standard practice. Although these guidelines do not appear to be followed by the majority of farmers, with these procedures remaining commonplace (DEFRA, 2006), their introduction may have resulted in greater awareness by farmers of the degree of pain they cause lambs. Greater awareness over the last twenty years, of the pain caused by these procedures may have had more impact upon the attitudes of younger farmers. It is possible that younger farmers are more open minded regarding animal welfare or have more knowledge of these newer guidelines. This may have contributed to their perceptions of the pain caused by castration and tail docking, which could partly explain the higher pain ratings given by less experienced farmers.

Significant differences were found between age groups in how students scored on the APL and BAM scales and in how they rated the Freedoms, with older students having higher scores. In addition the youngest student group, those aged 15-19, rated the pain capacity of all eight species the lowest, with those aged 20 and 21 giving significantly lower scores to fish and chickens than those aged 22 and above. These results suggest that attitudes towards animals and animal welfare improve with age in young adults. Although not directly comparable, a previous study of agriculture students found that older students scored higher on a component pertaining to animal welfare than younger students (Austin et al., 2005). This result could reflect the change in views and knowledge that occur over a student's academic career, both as a result of education but also from being exposed to a diverse array of perspectives from people with backgrounds different to their own.

5. Females are more empathic and perceive pain in others as more severe than do males

Throughout this research a number of gender effects were identified. For example female cattle farmers rated the pain associated with normal and difficult calving and mastitis significantly higher than did males, suggesting that females are more empathetic towards female-specific conditions. This finding was also seen in pig farmers and vets, with females rating the pain associated with normal and difficult farrowing higher than did males (Ison and Rutherford, 2014). This greater pain perception by females has been found in a number of studies (Capner et al., 1999; Ellingsen et al., 2010; Huxley and Whay, 2006; Ison and Rutherford, 2014; Kielland et al., 2009; Lascelles et al., 1999; Laven et al., 2009; Lorena et al., 2013; Raekallio et al., 2003; Wikman et al., 2013), but does not appear to be entirely consistent, with other studies finding no gender effect (Kielland et al., 2010; Muri and Valle, 2012), and differences varying between the condition or procedure in question and between study populations. For example this current research found a gender effect for seven out of the twelve conditions and procedures for cattle farmers, and no gender effect for sheep farmers, for any of the conditions or procedures.

Where differences have been found between males and females in how they perceive the pain of others, this may be indicative of differences in the underlying empathy levels of these two groups, as pain perception is believed to be closely related to empathy (Cervero, 2012 p135). However, research suggests that females may perceive others’ pain as more severe because females are better at detecting pain from facial expressions than males (Prkachin et al., 2004), a finding that may extend to how people perceive pain in animals. This is an interesting finding in light of the fact that females’ higher pain ratings have been attributed to greater levels of empathy, when they may be in fact be as a result of an enhanced ability to detect pain signals. In addition, studies have used people’s perceptions of pain as a measure of their empathetic tendencies (Jackson et al., 2006; Kielland et al., 2009). However this may not be an appropriate or accurate measurement of empathetic tendencies, as research suggests that people with certain personality disorders such as psychopaths have the ability to accurately recognise emotional states in others (cognitive empathy) but lack, or are limited in the ability to share in those emotions (affective empathy) (see Book et al., 2015). Therefore it is possible that people can be proficient at recognising facial signals of pain, but have no emotional reaction to that pain, therefore limiting the usefulness of pain perception as an empathy measure. Future research on the ability of males and females to detect pain signals in others would be an interesting and potentially important addition to the literature on how people recognise and share in the emotional states of others. Studies investigating empathetic tendencies suggest that females are more empathetic than males. For example a study of veterinary students revealed that females were more empathetic and more consistent in their levels of empathy over time than were males (Paul and Podberscek, 2000). These findings are supported in the current research, where female vet students were shown to have higher empathy towards lame sheep compared to their male counterparts. In addition female farmers and vets were found to be more compassionate towards sheep, less judgemental of others' emotional attachment to sheep, and there was a tendency towards a significant difference in the level of affective empathy towards sheep between males and females.

Attitudinal differences were also seen between the two genders. Female farmers and vets had a stronger belief in the benefits of analgesic use (benefits), and female agriculture and veterinary students were more positive towards pain and analgesic use in animals. Additionally, female students (irrespective of course) had a stronger belief in animal sentience, providing higher pain capacity scores for all eight species and scoring higher on the BAM scale, a finding seen in other research (Knight et al., 2004).

Throughout this project a number of gender differences were found, however there were also a number of occasions where no differences were seen. This highlights the difficulty of identifying true gender differences as there are likely to be other factors playing a role. In studies like these it can be especially difficult to identify gender differences due to the pre-existing gender skew towards males that exists in the farming world. Gender-skews are even more complicated in the veterinary world where an interaction with age exists, with 63% of female vets being under the age of 40, and 72% of male vets being over the age of 40. However, overall these results support previous findings that females perceive pain in others as more severe and that they are more likely to have stronger empathetic tendencies than males. Where inconsistencies in gender findings exist these may be partly explained by the differences between studies, which cover a range of nationalities and study populations, have large variation in the painful conditions and procedures presented, as well as variation in how these were presented to the subjects, the methods used for pain scoring and the tools used to measure empathy. However, the evidence presented here and elsewhere in the literature of a gender difference is compelling and may have implications for the management of pain and therefore animal welfare.

6. Farmer knowledge of how to assess and control pain in sheep may be improved by better communication with vets

The ability to recognise pain and the knowledge of how to treat it are paramount for good animal welfare. Cattle and sheep farmers (**chapter 2**) were asked to rate their ability to both assess and control pain in their animals. Whilst over 90 and 93% of cattle and sheep farmers respectively rated their ability to assess pain as either 'good', 'very good' or 'excellent', only 83 and 75% of farmers respectively considered their knowledge of how to control pain as 'good', 'very good' or 'excellent'. Twenty-five percent of sheep farmers rated their ability to control pain as less than 'fair'. This finding is of concern, when viewed in light of answers given by sheep farmers to questions concerning knowledge about drug availability, use and storage (**chapter 4** - study two). For instance, 24% of farmers did not know whether there were pain relieving drugs available for use in sheep and 24% of farmers answered 'true' or 'don't know' to the questions '*pain relieving drugs have to be administered by vets'* and *'farmers are not permitted to keep pain relieving drugs on farm'*. This highlights a potential problem in communication between farmers and their vet. If farmers are to make informed choices about how they manage pain in animals then efforts may need to be made to raise awareness of available analgesic options. When asked whether they had discussed with their vet the use of pain relieving drugs for lame sheep only 41% agreed. However 76% of farmers agreed that they would be comfortable asking their vet for these drugs, and 88% of vets agreed that they would be comfortable having this conversation with farmers. These results suggest that there is an opportunity for vets to start this conversation with their clients around the use of analgesia in sheep, and that farmers may be more willing to engage than vets currently believe.

This study found that 53% of vets believed that farmers did not think analgesia was necessary for lame sheep. However, no farmers agreed that pain relieving drugs were not necessary for lame sheep, and 28% said they didn't know. In addition when farmers were asked whether they thought pain relief should be part of the treatment of lame sheep 40% agreed, 18% said they did not know and 40% gave a neutral response. This further highlights the importance of improving communication between farmers and vets around the benefits of pain and pain management. Improved communication is especially important in the sheep industry where low economic margins reduce the likelihood of vets being called out for individual animals (Kaler and Green, 2013). Although there are roughly four times as many breeding sheep in the UK as breeding cows (dairy and beef combined), the sheep industry generates only one fifth of the revenue that cattle do (DEFRA et al., 2012). Results of a study conducted by the Royal College of Veterinary Surgeons found large differences in the amount of time vets spent working with different species; vets were noted to spend almost twice as much time working with beef cattle and three times as much time with dairy cattle than with sheep (Buzzeo et al., 2014). The greater cost of veterinary attention to sheep farmers, combined with the views of many sheep farmers that vets lack sufficient knowledge on sheep farming for their input to be considered valuable (Kaler and Green, 2013), means that many sheep farms have little or no involvement with a vet. Findings from the lameness and empathy study (**chapter four – study two**) showed that over 90% of farmers had not called a vet out for lame sheep in the previous twelve months. As pain medications need to be prescribed by a vet there is a risk that sheep pain will go untreated. In order for analgesic use in sheep to become routine practice, it is essential that farmers and vets communicate regarding the benefits of pain relief, and the options available to farmers to provide medication to their animals in a practical and cost efficient manner.

7. Limitations & Future directions

It is important to acknowledge that there is potential for a number of inherent biases in survey research. Sampling bias can occur when certain members of a population are less likely to be included than others, this can occur as a result of non-randomised sampling in which not all individuals have an equal chance of being selected. In order to address this potential issue a number of techniques were used. Farmers were selected for the postal distribution of the farmer questionnaire (**chapter two**) using proportional stratification, by region and by herd/flock size to ensure that a representative number of farmers from across the country were included. The collection of data at agriculture shows may have resulted in a biased sample, as perhaps those farmers who attend shows differ in some ways from those that do not. However local agriculture shows are an important part of the agricultural calendar and are attended by a large proportion of the farming community. For the student questionnaire (**chapter three**) blanket sampling was utilised, this meant that all eligible students (i.e. those studying an animal related subject at any of the academic institutions that had agreed to participate) were given the opportunity to participate.

Self-selection bias can occur where participation is voluntary and those who choose to participate do so because they are interested in, or have strong views on, the topic in question. This can introduce bias and result in an unrepresentative sample of the study population. This is likely to be the main source of potential bias for this research, as all participation was voluntary.

Social desirability bias may occur where participants provide the answers they think the researcher is looking for, or that are deemed more socially acceptable, but not necessarily truly representative of their own views. However this is primarily an issue with interviewer led surveys, and much less of an issue with self-completion surveys. Similarly the order in which questions are presented may influence answers to subsequent questions. This research addressed the issue of question order bias in three of its four studies. In the two online questionnaires (**chapter 3 and chapter 4** – study two) randomised ordering of questions within each section was implemented. In the lameness and pain perception study (**chapter 4** – study one) the order in which the video clips of the sheep were shown varied between participants. Unfortunately randomisation of question order was not feasible for the farmer questionnaire (**chapter two**) as this was conducted with a paper questionnaire.

The issues of sampling and response bias however are inherent in most survey studies and are difficult, if not impossible, to prevent. Nevertheless these inherent issues with survey style studies do not render their contribution without value. Instead they require that an acknowledgement be made to their potential existence and that caution be taken when discussing the findings. Survey studies do provide a valuable method by which views and attitudes of populations can be better understood.

A limitation of this thesis is that potential relationships between attitudes and behaviour could not be investigated. Fully understanding the impact of attitudes upon human-animal interactions requires that human behavioural measures also be recorded, thus allowing for a greater understanding of how the two relate. Furthermore, in order to investigate what human attitudes and behaviour ultimately mean for the welfare of animals, animal behavioural and welfare outcomes also need to be recorded. Future studies that encompass all of these aspects will provide the most comprehensive understanding of how animal welfare is affected by human attitude and behaviour.

8. Implications & Conclusions

Overall, positive attitudes towards animal pain and welfare were found across all four studies. However variation in attitudes was seen between professions, student groups, genders and across different age groups and experience levels. This suggests that there are a number of factors that affect individuals' attitudes, and these differences highlight areas where there may be implications for animal welfare. Having a better understanding of how these and other factors influence the development of animal based attitudes and their subsequent effect on behaviour is essential for understanding how the welfare of animals may be affected.

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Appendices

Appendix I

Sheep Farmer Questionnaire – chapter two

Understanding Farmers' Views on Pain in Cattle

This questionnaire is part of a PhD student project looking at farmers views on pain in cattle.
The questionnaire consists primarily of multiple choice questions and will take less than 10 minutes to complete.

All respondents will be entered into a PRIZE DRAW to win £100.
Your contact information will be separated from the questionnaire and your responses anonymised.

Section One

Q1. How many years have you worked with cattle?

Q2. What is the total number of cattle you currently work with?

Q3. What type(s) of production do you work in?

Dairy ☐
Beef ☐
Veal ☐

Section Two

Q4. How would you rate your ability to assess pain in cattle?

Excellent ☐
Very good ☐
Good ☐
Fair ☐
Poor ☐
Very Poor ☐
No ability ☐
Don't know ☐

Q5. How would you rate your knowledge of how to control pain in cattle?

Excellent ☐
Very good ☐
Good ☐
Fair ☐
Poor ☐
Very poor ☐
No ability ☐
Don't know ☐

Q6. In your opinion, how painful are the following conditions and procedures when experienced at their WORST if NO pain relieving drugs are given. Please select the term that you think best describes the amount of pain a cow is likely to experience

	No Pain	*Mild Pain*	*Moderate Pain*	*Severe Pain*	*Worst Pain*	*Don't Know*
Lameness	☐	☐	☐	☐	☐	☐
Mastitis	☐	☐	☐	☐	☐	☐
Ear marking (tagging etc.)	☐	☐	☐	☐	☐	☐
Freeze Branding	☐	☐	☐	☐	☐	☐
Hot Iron Branding	☐	☐	☐	☐	☐	☐
Castration	☐	☐	☐	☐	☐	☐
Tail docking	☐	☐	☐	☐	☐	☐
Dehorning (adults)	☐	☐	☐	☐	☐	☐
Disbudding (calves)	☐	☐	☐	☐	☐	☐
Normal calving - no assistance	☐	☐	☐	☐	☐	☐
Difficult calving - required assistance	☐	☐	☐	☐	☐	☐
Caesarean section	☐	☐	☐	☐	☐	☐

Section Three

Please place a single downward line | through each of the lines below, at the point you feel best represents how much you agree or disagree with each of the following statements

It is acceptable if farm animals are sometimes hungry

Strongly Agree Strongly Disagree

It is acceptable if farm animals sometimes don't have shelter and a comfortable resting area

Strongly Agree Strongly Disagree

It is acceptable if sick farm animals are not always treated promptly

Strongly Agree Strongly Disagree

It is acceptable if farm animals in pain are not always given pain relief

Strongly Agree Strongly Disagree

It is acceptable if farm animals are not always able to express normal behaviour

Strongly Agree Strongly Disagree

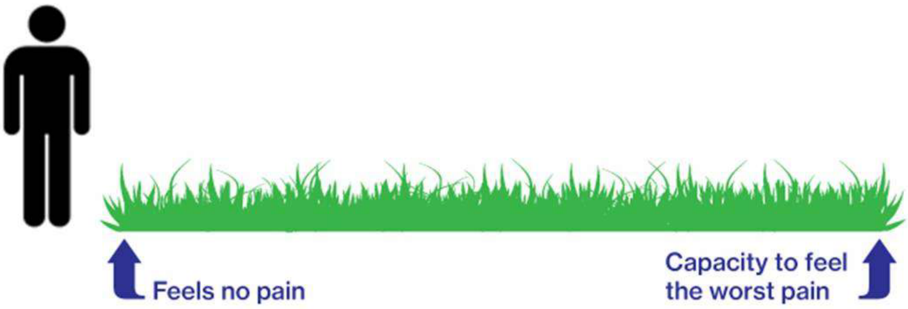
It is acceptable if farm animals sometimes experience fear or distress

Strongly Agree Strongly Disagree

Section Four

Please place a single downward line | through each line below, at the point you feel best represents that species capacity to feel pain

Humans



Sheep

Turkeys

Cattle

Section Five

Please state how strongly you agree or disagree with the following statements, by ticking the appropriate box

	Strongly agree	*Agree*	*Neither Agree or Disagree*	*Disagree*	*Strongly Disagree*
Farm animals benefit from pain alleviation	☐	☐	☐	☐	☐
The current management of animals at my farm offers sufficient opportunity to identify animals in pain	☐	☐	☐	☐	☐
Pain relief drugs are too expensive to use regularly	☐	☐	☐	☐	☐
Providing pain relief is impractical most of the time as a result of the need for increased time and labour	☐	☐	☐	☐	☐
Difficulties with gathering and/or handling means that it is very difficult to administer pain relief	☐	☐	☐	☐	☐
Pain relieving drugs are not necessary for farm animals	☐	☐	☐	☐	☐
In general I am happy to pay the cost involved with giving pain relieving drugs	☐	☐	☐	☐	☐
Farm animals recover better from an injury, disease or painful procedures when given pain relief drugs	☐	☐	☐	☐	☐
It is difficult to recognise pain in farm animals	☐	☐	☐	☐	☐
Some degree of pain is beneficial to the animal	☐	☐	☐	☐	☐

Section Six

Q16. Are you male or female?

Male........................ ☐ *Female*................... ☐

Q17. In what year were you born?

☐

Q18. Where do you live?

England.. ☐

Scotland... ☐

Wales... ☐

Northern Ireland.. ☐

Rep. of Ireland.. ☐

Other - please specify.. ☐

Thank you for taking part in this study, your participation is greatly appreciated.
To be entered into the prize draw for £100 please provide your contact details below.

Your contact details will be separated from this questionnaire.

Please tick the box if you would like to receive information about the results of this study ☐

Name

Phone Number

Email Address OR Postal Address

Appendix II

Cattle Farmer Questionnaire – chapter two

Understanding Farmers' Views on Pain in Cattle

This questionnaire is part of a PhD student project looking at farmers views on pain in cattle.
The questionnaire consists primarily of multiple choice questions and will take less than 10 minutes to complete.

All respondents will be entered into a PRIZE DRAW to win £100.
Your contact information will be separated from the questionnaire and your responses anonymised.

Section One

Q1. How many years have you worked with cattle?

Q2. What is the total number of cattle you currently work with?

Q3. What type(s) of production do you work in?

- *Dairy* ☐
- *Beef* ☐
- *Veal* ☐

Section Two

Q4. How would you rate your ability to assess pain in cattle?

- *Excellent* ☐
- *Very good* ☐
- *Good* ☐
- *Fair* ☐
- *Poor* ☐
- *Very Poor* ☐
- *No ability* ☐
- *Don't know* ☐

Q5. How would you rate your knowledge of how to control pain in cattle?

- *Excellent* ☐
- *Very good* ☐
- *Good* ☐
- *Fair* ☐
- *Poor* ☐
- *Very poor* ☐
- *No ability* ☐
- *Don't know* ☐

Q6. In your opinion, how painful are the following conditions and procedures when experienced at their WORST if NO pain relieving drugs are given. Please select the term that you think best describes the amount of pain a cow is likely to experience

	No Pain	*Mild Pain*	*Moderate Pain*	*Severe Pain*	*Worst Pain*	*Don't Know*
Lameness	☐	☐	☐	☐	☐	☐
Mastitis	☐	☐	☐	☐	☐	☐
Ear marking (tagging etc.)	☐	☐	☐	☐	☐	☐
Freeze Branding	☐	☐	☐	☐	☐	☐
Hot Iron Branding	☐	☐	☐	☐	☐	☐
Castration	☐	☐	☐	☐	☐	☐
Tail docking	☐	☐	☐	☐	☐	☐
Dehorning (adults)	☐	☐	☐	☐	☐	☐
Disbudding (calves)	☐	☐	☐	☐	☐	☐
Normal calving - no assistance	☐	☐	☐	☐	☐	☐
Difficult calving - required assistance	☐	☐	☐	☐	☐	☐
Caesarean section	☐	☐	☐	☐	☐	☐

Section Three

Please place a single downward line | through each of the lines below, at the point you feel best represents how much you agree or disagree with each of the following statements

It is acceptable if farm animals are sometimes hungry

Strongly Agree Strongly Disagree

It is acceptable if farm animals sometimes don't have shelter and a comfortable resting area

Strongly Agree Strongly Disagree

It is acceptable if sick farm animals are not always treated promptly

Strongly Agree Strongly Disagree

It is acceptable if farm animals in pain are not always given pain relief

Strongly Agree Strongly Disagree

It is acceptable if farm animals are not always able to express normal behaviour

Strongly Agree Strongly Disagree

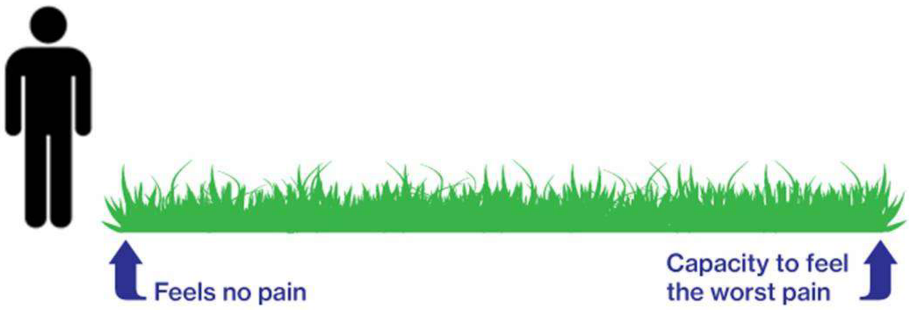
It is acceptable if farm animals sometimes experience fear or distress

Strongly Agree Strongly Disagree

Section Four

Please place a single downward line | through each line below, at the point you feel best represents that species capacity to feel pain

Humans



Sheep

Turkeys

Cattle

Section Five

Please state how strongly you agree or disagree with the following statements, by ticking the appropriate box

	Strongly agree	*Agree*	*Neither Agree or Disagree*	*Disagree*	*Strongly Disagree*
Farm animals benefit from pain alleviation	☐	☐	☐	☐	☐
The current management of animals at my farm offers sufficient opportunity to identify animals in pain	☐	☐	☐	☐	☐
Pain relief drugs are too expensive to use regularly	☐	☐	☐	☐	☐
Providing pain relief is impractical most of the time as a result of the need for increased time and labour	☐	☐	☐	☐	☐
Difficulties with gathering and/or handling means that it is very difficult to administer pain relief	☐	☐	☐	☐	☐
Pain relieving drugs are not necessary for farm animals	☐	☐	☐	☐	☐
In general I am happy to pay the cost involved with giving pain relieving drugs	☐	☐	☐	☐	☐
Farm animals recover better from an injury, disease or painful procedures when given pain relief drugs	☐	☐	☐	☐	☐
It is difficult to recognise pain in farm animals	☐	☐	☐	☐	☐
Some degree of pain is beneficial to the animal	☐	☐	☐	☐	☐

Section Six

Q16. Are you male or female?

Male .... ☐ *Female* .... ☐

Q17. In what year were you born?

☐

Q18. Where do you live?

England .... ☐

Scotland .... ☐

Wales .... ☐

Northern Ireland .... ☐

Rep. of Ireland .... ☐

Other - please specify .... ☐

Thank you for taking part in this study, your participation is greatly appreciated.
To be entered into the prize draw for £100 please provide your contact details below.

Your contact details will be separated from this questionnaire.

Please tick the box if you would like to receive information about the results of this study ☐

Name

Phone Number

Email Address OR Postal Address

Appendix III

Undergraduate Student Questionnaire – chapter three

text only

UG

Understanding Students' Attitudes to Animal Welfare

The information you provide in this questionnaire will be seen only by those directly involved in this project
Your answers are anonymous

By clicking on the arrow below you are consenting to take part in this questionnaire

Progress

Next

text only

How old are you?

Are you?

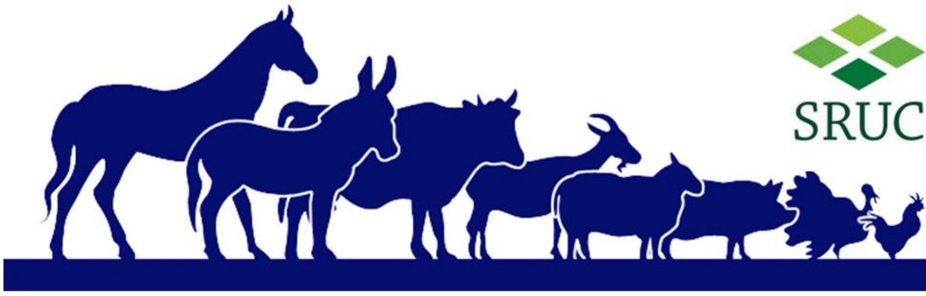
- *Male*
- *Female*
- *Prefer not to say*

Other - please specify

Progress

Next

text only



At which University/College do you study?

Which of the following best describes your area of study?

- ○ *Agriculture/Agricultural Science*
- ○ *Animal Care/Management*
- ○ *Animal Behaviour & Welfare*
- ○ *Aquaculture/Sport Fisheries Management*
- ○ *Biology/Biological Science*
- ○ *Equine Studies*
- ○ *Psychology/Social Science*
- ○ *Veterinary Medicine/Science*
- ○ *Veterinary Nursing*
- ○ *Zoology*

Other - please specify

What year are you in?

- ○ *1st*
- ○ *2nd*
- ○ *3rd*
- ○ *4th*
- ○ *5th*
- ○ *6th*

Progress

Next

text only

Not including experience gained during your studies, which of the following animals species do you have experience of working with?
Please tick all that apply

- ☐ *Cattle*
- ☐ *Chicken/Hens*
- ☐ *Dogs*
- ☐ *Fish*
- ☐ *Horses*
- ☐ *Pigs*
- ☐ *Sheep*

Other - please specify

Progress

Next

text only

Please indicate how much you agree or disagree with the following statements, by moving each slider to a point on the line from Strongly Agree on the left hand side to Strongly Disagree on the right hand side

It is acceptable if farm animals are sometimes hungry

Strongly Agree — Strongly Disagree

It is acceptable if farm animals sometimes don't have shelter and a comfortable resting area

Strongly Agree — Strongly Disagree

It is acceptable if sick farm animals are not always treated promptly

Strongly Agree — Strongly Disagree

It is acceptable if farm animals in pain are not always given pain relief

Strongly Agree — Strongly Disagree

It is acceptable if farm animals are not always able to express normal behaviour

Strongly Agree — Strongly Disagree

It is acceptable if farm animals sometimes experience fear and distress

Strongly Agree — Strongly Disagree

Progress

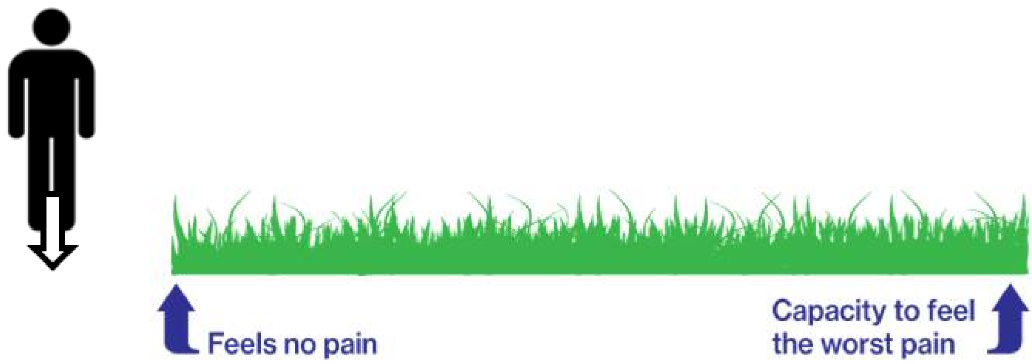
Next

text only

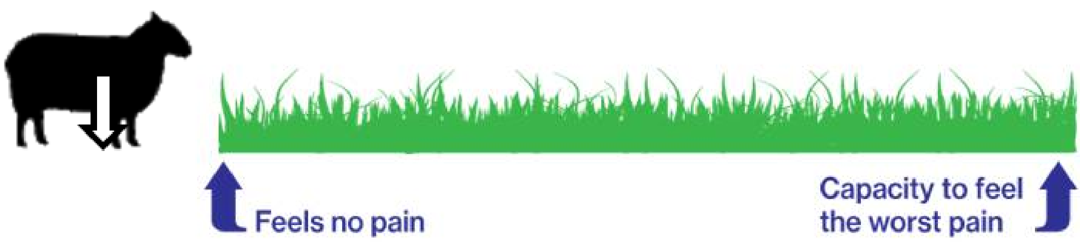
Please move the images below to a point on their line that you believe best represents that species' capacity to feel pain

The far left of the line represents 'Feels no pain' while the right hand side represents 'Capacity to feel the worst pain'

Humans



Sheep



Chickens/Hens

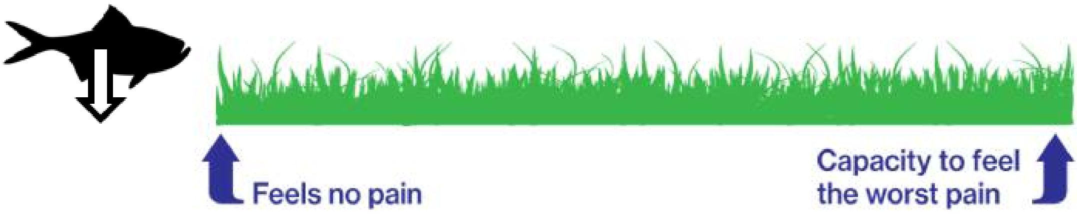
Cattle

Pigs

Dogs

Horses

Fish



Progress

Next

text only

Please indicate how strongly you agree or disagree with the following statements by clicking on the appropriate circle

	Strongly Agree	*Agree*	*Neither Agree nor Disagree*	*Disagree*	*Strongly Disagree*	*I don't know*
Some degree of pain is beneficial to farm animals	○	○	○	○	○	○
It is difficult to recognise pain in farm animals	○	○	○	○	○	○
Farm animals benefit from pain alleviation	○	○	○	○	○	○
Pain relieving drugs are not necessary for farm animals	○	○	○	○	○	○

Progress

Next

text only

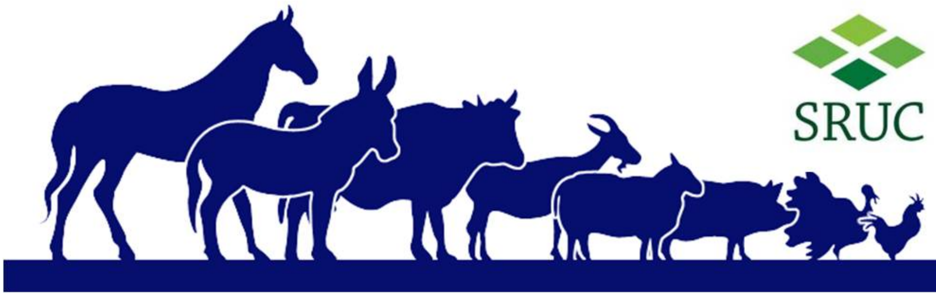
Please click on the circle that most closely represents how you feel about each of the following four statements

	Yes, definitely	*Yes, probably*	*Possibly, to a limited extent*	*No, probably not*	*No, definitely not*	*I don't know*
Most animals are *unaware* of what is happening to them	○	○	○	○	○	○
Most animals *are capable* of experiencing a range of feelings and emotions	○	○	○	○	○	○
Most animals are *unaware* of what they are doing, mechanically responding to instinctive urges without awareness	○	○	○	○	○	○
Most animals *are able* to think to some extent to solve problems and make decisions about what to do	○	○	○	○	○	○

Progress

Submit

text only



Thank you for taking the time to complete this questionnaire

Progress

Submit

Appendix IV

Postgraduate Student Questionnaire – chapter three

text only

MSc

Understanding Attitudes to Animal Welfare

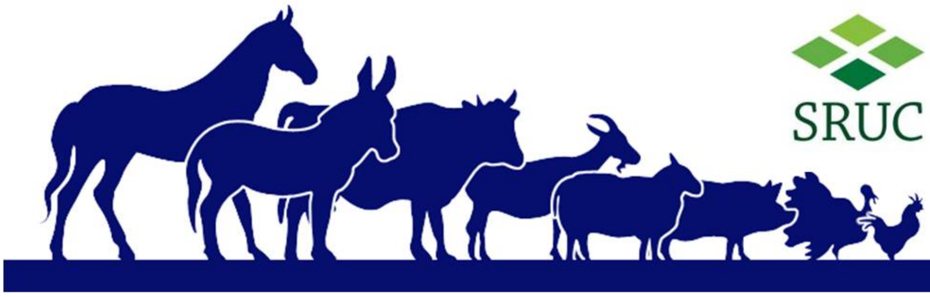
The information you provide in this questionnaire will be seen only by those directly involved in this project
Your answers are anonymous

By clicking on the arrow below you are consenting to take part in this questionnaire

Progress

Next

text only



How old are you?

Are you?

- ◯ *Male*
- ◯ *Female*
- ◯ *Prefer not to say*

Other - please specify

At which University/College do you study?

What is the title of your course?

- ◯ *MSc (Applied) Animal Behaviour & Welfare*
- ◯ *MSc (International) Animal Welfare, Ethics & Law*
- ◯ *MSc Poultry Production*
- ◯ *MSc Organic Farming*
- ◯ *PG Dip Organic Farming*

Other - please specify

Progress

Next

text only

Not including experience gained during your studies, which of the following animals species do you have experience of working with?
Please tick all that apply

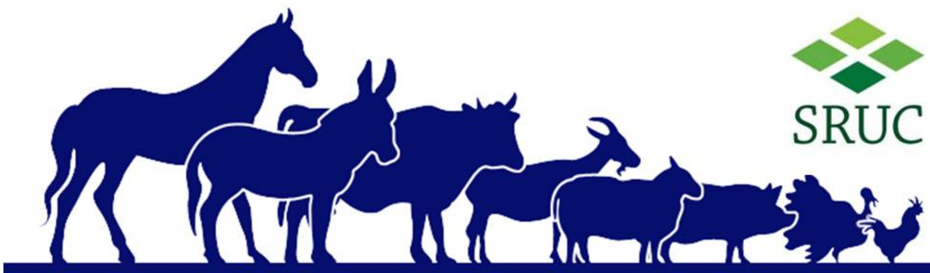
- [ ] *Cattle*
- [ ] *Chicken/Hens*
- [ ] *Dogs*
- [ ] *Fish*
- [ ] *Horses*
- [ ] *Pigs*
- [ ] *Sheep*

Other - please specify

Progress

Next

text only



Please indicate how much you agree or disagree with the following statements, by moving each slider to a point on the line from Strongly Agree on the left hand side to Strongly Disagree on the right hand side

It is acceptable if farm animals are sometimes hungry

Strongly Agree — Strongly Disagree

It is acceptable if farm animals sometimes don't have shelter and a comfortable resting area

Strongly Agree — Strongly Disagree

It is acceptable if sick farm animals are not always treated promptly

Strongly Agree — Strongly Disagree

It is acceptable if farm animals in pain are not always given pain relief

Strongly Agree — Strongly Disagree

It is acceptable if farm animals are not always able to express normal behaviour

Strongly Agree — Strongly Disagree

It is acceptable if farm animals sometimes experience fear and distress

Strongly Agree — Strongly Disagree

Progress

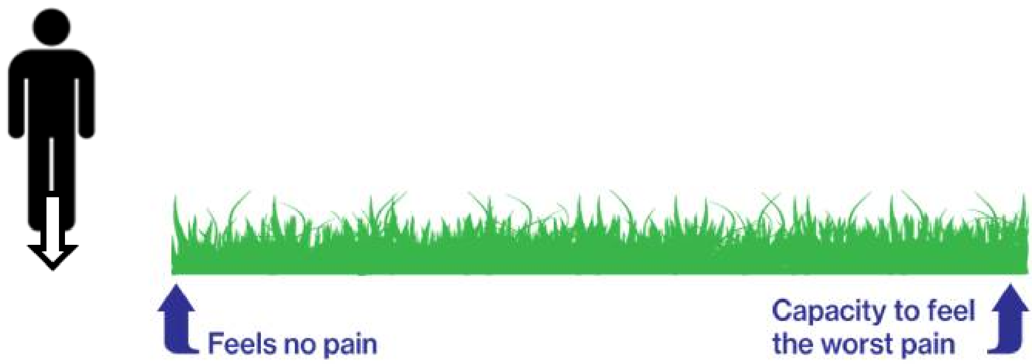
Next

[text only]

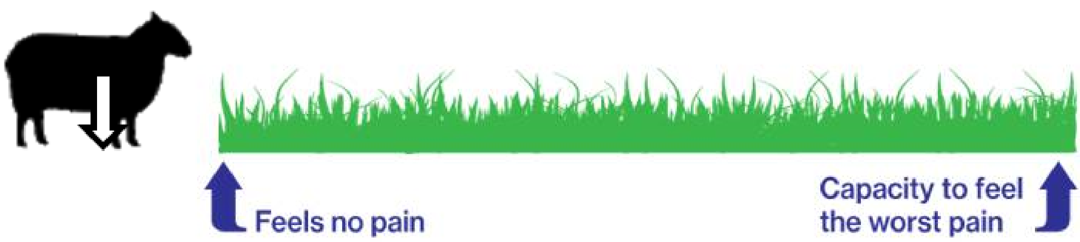
Please move the images below to a point on their line that you believe best represents that species' capacity to feel pain

The far left of the line represents 'Feels no pain' while the right hand side represents 'Capacity to feel the worst pain'

Humans



Sheep



Chickens/Hens

Cattle

Pigs

Dogs

Horses

Fish

Progress

Next

text only

Please indicate how much you agree or disagree with the following statements by clicking on the appropriate circle

	Strongly Agree	*Agree*	*Neither Agree nor Disagree*	*Disagree*	*Strongly Disagree*	*I don't know*
It is difficult to recognise pain in farm animals	○	○	○	○	○	○
Some degree of pain is beneficial to farm animals	○	○	○	○	○	○
Pain relieving drugs are not necessary for farm animals	○	○	○	○	○	○
Farm animals benefit from pain alleviation	○	○	○	○	○	○

Progress

Next

text only

Please click on the circle that most closely represents how you feel about each of the following four statements

	Yes, definitely	*Yes, probably*	*Possibly, to a limited extent*	*No, probably not*	*No, definitely not*	*I don't know*
Most animals are *unaware* of what they are doing, mechanically responding to instinctive urges without awareness						
Most animals *are able* to think to some extent to solve problems and make decisions about what to do						
Most animals are *unaware* of what is happening to them						
Most animals *are capable* of experiencing a range of feelings and emotions						

Progress

Next

text only

Thank you for taking the time to complete this questionnaire

Progress

Submit

Appendix V

Lameness & Pain Perception Questionnaire– chapter four - study one

Movie Number

Age

Gender

Nationality

Clip A

Please place a single downward line | through the line below, at the point that represents how lame you think this sheep was.

Sound — Couldn't be more Lame

Please place a single downward line | through the line below, at the point that represents how much pain you think this sheep was in.

No Pain — Worst Pain Imaginable

Please place a single downward line | through the line below, at the point that represents how much of a negative emotional reaction you had to this clip. For example: anger, concern, sadness

No Negative Reaction — Strongest Possible Negative Reaction

Would you catch this sheep to check its feet?

Yes .... ☐
No .... ☐
Maybe, depending upon the condition of other sheep in the group .... ☐

Clip B

Please place a single downward line | through the line below, at the point that represents how lame you think this sheep was.

Sound	Couldn't be more Lame

Please place a single downward line | through the line below, at the point that represents how much pain you think this sheep was in.

No Pain	Worst Pain Imaginable

Please place a single downward line | through the line below, at the point that represents how much of a negative emotional reaction you had to this clip. For example: anger, concern, sadness

No Negative Reaction	Strongest Possible Negative Reaction

Would you catch this sheep to check its feet?

Yes .... ☐
No .... ☐
Maybe, depending upon the condition of other sheep in the group .... ☐

Clip C

Please place a single downward line | through the line below, at the point that represents how lame you think this sheep was.

Sound — Couldn't be more Lame

Please place a single downward line | through the line below, at the point that represents how much pain you think this sheep was in.

No Pain — Worst Pain Imaginable

Please place a single downward line | through the line below, at the point that represents how much of a negative emotional reaction you had to this clip. For example: anger, concern, sadness

No Negative Reaction — Strongest Possible Negative Reaction

Would you catch this sheep to check its feet?

Yes .... ☐
No .... ☐
Maybe, depending upon the condition of other sheep in the group .... ☐

Clip D

Please place a single downward line | through the line below, at the point that represents how lame you think this sheep was.

Sound — Couldn't be more Lame

Please place a single downward line | through the line below, at the point that represents how much pain you think this sheep was in.

No Pain — Worst Pain Imaginable

Please place a single downward line | through the line below, at the point that represents how much of a negative emotional reaction you had to this clip. For example: anger, concern, sadness

No Negative Reaction — Strongest Possible Negative Reaction

Would you catch this sheep to check its feet?

Yes .... ☐
No .... ☐
Maybe, depending upon the condition of other sheep in the group .... ☐

Clip E

Please place a single downward line | through the line below, at the point that represents how lame you think this sheep was.

Sound | Couldn't be more Lame

Please place a single downward line | through the line below, at the point that represents how much pain you think this sheep was in.

No Pain | Worst Pain Imaginable

Please place a single downward line | through the line below, at the point that represents how much of a negative emotional reaction you had to this clip. For example: anger, concern, sadness

No Negative Reaction | Strongest Possible Negative Reaction

Would you catch this sheep to check its feet?

Yes .... ☐
No .... ☐
Maybe, depending upon the condition of other sheep in the group .... ☐

Appendix VI

Lameness & Empathy - Farmer Questionnaire – chapter four - study two

Lameness Management & Views on Pain

Section 1 - About You & Your Farm

If you are both a sheep farmer and a veterinarian, please tick this box

☐

Are you?

- ◯ *Male*
- ◯ *Female*

In what year where you born?

[ ]

Where do you live?

- ◯ *England*
- ◯ *Scotland*
- ◯ *Wales*
- ◯ *Northern Ireland*
- ◯ *Republic of Ireland*

Other - please specify

[ ]

Which of the following best describes you?

- ◯ *Farm owner*
- ◯ *Farm owner & manager*
- ◯ *Farm manager*
- ◯ *Shepherd*
- ◯ *Stock worker*
- ◯ *Retired*

Other - please specify

[ ]

What is your highest educational qualification?

- ◯ *No qualification*
- ◯ *School*
- ◯ *College*
- ◯ *University*
- ◯ *Masters*
- ◯ *PhD*

Other - please specify

[ ]

How many breeding ewes do you currently have?

How many years have you worked with sheep?

Comment Box - Please use this space if you wish to make a comment or expand on any of your answers.

Next

Section 2 - Treatment of a Lame Ewe

The following questions correspond to the video and photograph below

Click on the play button and watch the video, then look at the photograph and answer the following questions

If the video does not play you can view it on this webpage:

vimeo.com/99829741

Sheep Lameness Study - video for questionnare

from **Scotland's Rural College** PRO

00:21

Imagine the ewe in the video was one of your sheep.
You see that she is lame so you catch and turn her to look at her feet.

This photograph is what you see when you turn her - left fore foot.

Please drag the slider to a point on the scale below that represents how much pain you think the ewe was in.

No Pain

Worst Pain Imaginable

Based on what you saw in the video and photograph would you...?

	Yes	*No*	*Maybe*
Spray foot with an antibiotic/disinfectant spray	◯	◯	◯
Inject with an antibiotic	◯	◯	◯
Give an anti-inflammatory/Pain relieving drug	◯	◯	◯
Trim hoof	◯	◯	◯
Footbathe	◯	◯	◯
Separate from the rest of the flock	◯	◯	◯
Turn back out with the flock	◯	◯	◯
Cull	◯	◯	◯
Get the vet out	◯	◯	◯

Comment Box - Please use this space if you wish to make a comment or expand on any of your answers.

Next

Section 3 - Management of Lameness

The following questions are about your current lameness management practices

Please select one flock on your farm and answer the following questions based on this one flock

Is this flock?

- ☐ Hill
- ☐ Upland
- ☐ Lowland

How many breeding ewes are in this flock?

Approximately how many of these breeding ewes were lame at least once over the last 12 months?

Over the last 12 months as part of standard lameness management did you....?

	Yes	*No*	*N/A*
Routine foot trim whole flock	○	○	○
Routine footbath whole flock	○	○	○
Vaccinate flock against footrot	○	○	○
Apply lime e.g to pens/races/around feeders	○	○	○
Move around mineral buckets or feeders in fields	○	○	○

Over the last 12 months as part of infectious lameness management how often did you....?

	Always/Almost always	*Often*	*Sometimes*	*Rarely*	*Never*
Therapeutically trim individuals	○	○	○	○	○
Foot-bathe infected individuals	○	○	○	○	○
Use antibiotic or disinfectant foot spray	○	○	○	○	○
Use antibiotic injections	○	○	○	○	○
Separate lame ewes from the rest of flock	○	○	○	○	○
Quarantine new stock	○	○	○	○	○
Turn treated animals out onto a clean and dry area	○	○	○	○	○
Catch and treat mildly lame sheep	○	○	○	○	○
Cull repeatedly lame sheep	○	○	○	○	○
Treat lame sheep within 3 days of noticing them	○	○	○	○	○
Give anti-inflammatories/pain relieving drugs as part of lameness treatment	○	○	○	○	○

What are the names of the drugs that you or your vet use when treating lameness?

Injectable antibiotics

Antibiotic/Disinfectant Sprays

Anti-inflammatories/Pain Relieving Drugs

In the last 12 months how many times have you called a vet out for lame sheep?

Comment Box - Please use this space if you wish to make a comment or expand on any of your answers.

Next

Section 4a- Your opinions on lameness and pain in sheep

The following questions are about your views and opinions, there are no right or wrong answers

Below there are a series of statements, please indicate how much you agree or disagree with each statement

	Completely Agree 1	*2*	*3*	*4*	*5*	*Completely Disagree 6*
Farmers that talk to their sheep annoy me	○	○	○	○	○	○
Many farmers are over affectionate towards their sheep	○	○	○	○	○	○
It upsets me to see or hear about sheep that have been attacked or killed by dogs	○	○	○	○	○	○
It upsets me to see sick sheep	○	○	○	○	○	○
It makes me sad to see sheep isolated from the rest of the flock	○	○	○	○	○	○

	Completely Agree 1	*2*	*3*	*4*	*5*	*Completely Disagree 6*
Seeing healthy sheep nearly always puts me in a good mood	○	○	○	○	○	○
I enjoy patting or stroking pet lambs	○	○	○	○	○	○
As a farmer I get personal satisfaction from helping sheep in pain or distress	○	○	○	○	○	○
It is silly to become emotionally attached to a sheep	○	○	○	○	○	○
People often make too much of the feelings of sheep	○	○	○	○	○	○

	Completely Agree 1	*2*	*3*	*4*	*5*	*Completely Disagree 6*
When a sheep is in pain or distress I want to help it	○	○	○	○	○	○
I do all I can do reduce the amount of stress sheep experience from gathering or handling	○	○	○	○	○	○
It irritates me when pet lambs play around my feet	○	○	○	○	○	○
I don't like being around sheep when they are in pain	○	○	○	○	○	○
Trying to limit the fear sheep experience is a waste of time as they are naturally fearful	○	○	○	○	○	○

Comment Box - Please use this space if you wish to make a comment or expand on any of your answers.

Next

Section 4b - Your opinions on lameness and pain in sheep

Below there are a series of statements, please indicate how much you agree or disagree with each statement

	Completely Agree 1	*2*	*3*	*4*	*5*	*Completely Disagree 6*	*Don't Know*
Including pain relieving drugs in the treatment of lame sheep improves their welfare	○	○	○	○	○	○	○
Lame sheep benefit from pain relieving drugs as part of their treatment	○	○	○	○	○	○	○
If pain relieving drugs were cheaper I would use them more often when treating lame sheep	○	○	○	○	○	○	○
Including pain relieving drugs in the treatment of lame sheep improves their performance	○	○	○	○	○	○	○
Including pain relieving drugs in the treatment of lame ewes improves the performance of their lambs	○	○	○	○	○	○	○

	Completely Agree 1	*2*	*3*	*4*	*5*	*Completely Disagree 6*	*Don't Know*
Pain relieving drugs are not necessary for lame sheep	○	○	○	○	○	○	○
It is difficult to recognise pain in sheep	○	○	○	○	○	○	○
Treating the disease is the same as alleviating the pain	○	○	○	○	○	○	○
Some degree of pain is beneficial to sheep	○	○	○	○	○	○	○
I think that pain relief should be part of the treatment of lame sheep	○	○	○	○	○	○	○
Sheep experience pain in the same way as humans	○	○	○	○	○	○	○

Below there are a series of statements, please indicate whether you think they are true or false

	True	*False*	*Don't Know*
Farmers are not permitted to keep pain relieving drugs on farm	○	○	○
Pain relieving drugs have to be administered by vets	○	○	○
There are no pain relieving drugs available for use in sheep	○	○	○

Comment Box - Please use this space if you wish to make a comment or expand on any of your answers.

Next

Section 5 - Your Vet

Below there are a series of statements about your vet, please indicate how much you agree or disagree with each statement

	Completely Agree 1	*2*	*3*	*4*	*5*	*Completely Disagree 6*	*Don't Know*
My vet doesn't think pain relieving drugs are necessary for lame sheep	○	○	○	○	○	○	○
My vet won't prescribe pain relieving drugs for lame sheep	○	○	○	○	○	○	○
My vet has discussed with me the use of pain relieving drugs for lame sheep	○	○	○	○	○	○	○
I would feel comfortable asking my vet for pain relieving drugs for lame sheep	○	○	○	○	○	○	○

Section 6 - Opinions of Others

Please indicate how much you think others would approve or disapprove of you giving pain relieving drugs to lame sheep as part of their treatment

	Highly Approve 1	*2*	*3*	*4*	*5*	*Highly Disapprove 6*
How much would **other farmers** approve of you giving pain relieving drugs to lame sheep?	○	○	○	○	○	○
How much would **your vet** approve of you giving pain relieving drugs to lame sheep?	○	○	○	○	○	○
How much would **your family** approve of you giving pain relieving drugs to lame sheep?	○	○	○	○	○	○

Section 7 - Giving Pain Relieving Drugs

	Total Control 1	*3*	*4*	*5*	*No Control 6*
How much **personal control** do you have over whether lame sheep on your farm receive pain relieving drugs as part of their treatment?	○	○	○	○	○

	Very Confident 1	*2*	*3*	*4*	*5*	*Not at all Confident 6*
How **confident** are you that you can provide pain relieving drugs as part of the treatment of lame sheep on your farm?	○	○	○	○	○	○

	Very Likely 1	2	3	4	5	Not at all Likely 6
How **likely** is it that you will provide pain relieving drugs as part of the treatment of lame sheep on your farm **over the next 12 months**?	○	○	○	○	○	○

Comment Box - Please use this space if you wish to make a comment or expand on any of your answers.

Next

Thank You!

We are extremely grateful to you for taking the time to complete this questionnaire

To say thank you we invite you to enter the prize draw for a chance to win £100

To do so please enter your details below and then click on 'Submit'

Your contact details will be separated from your questionnaire responses, and your answers will remain anonymous.
Your contact details will be used only by SRUC researchers to contact you with regard to this study.
Your contact details will not be shared with any other organisation.

Name

Email Address

Phone Number

You will be sent a report on the results of this study. If you do not wish to receive this please tick this box

☐

Submit

Appendix VII

Lameness & Empathy - Veterinarian Questionnaire – chapter four - study two

Lameness Management & Views on Pain

Section 1 - About You & Your Practice

If you are both a veterinarian and a sheep farmer please tick this box

☐

Are you?

- *Male*
- *Female*

In what year where you born?

Where do you live?

- *England*
- *Scotland*
- *Wales*
- *Northern Ireland*
- *Republic of Ireland*

Other - please specify

What is your highest educational qualification?

- *Veterinary School*
- *Certificate e.g CertAVP*
- *Diploma e.g DipECBHM, DBR*
- *Fellowship e.g FRCVS*
- *Masters*
- *PhD*

Other - please specify

In what year did you graduate from veterinary school?

Which of the following best describes your current practice?

- *More than 75% large animal*
- *Between 51 and 75% large animal*
- *Between 25 and 50% large animal*
- *Less than 25% large animal*
- *Retired*

Other - please specify

Including you how many veterinarians work at your current practice?

What is the approximate percentage of your veterinary work that involves sheep?

Are you a sheep specialist?

- ◯ *Yes*
- ◯ *No*

Comment Box - Please use this space if you wish to make a comment or expand on any of your answers

Progress

Next

Section 2 - Treatment of a Lame Ewe

The following questions correspond to the video and photograph below

Click on the play button, watch the video, then look at the photograph and answer the following questions

If the video does not play you can view it on this webpage:

https://vimeo.com/99829741

Sheep Lameness Study - video for questionnare

from **Scotland's Rural College** PRO

00:21

Imagine the ewe in the video was one of your client's sheep.
You see that she is lame so you catch and turn her to look at her feet.

The photograph is what you see when you turn her - left fore foot.

Please drag the slider to a point on the scale below that represents how much pain you think the ewe was in.

No Pain

Worst Pain Imaginable

Based on what you saw in the video and photograph would you...?

	Yes	*No*	*Maybe*
Spray foot with an antibiotic/disinfectant spray	◯	◯	◯
Inject with an antibiotic	◯	◯	◯
Give an anti-inflammatory/Pain relieving drug	◯	◯	◯
Trim hoof	◯	◯	◯
Footbathe	◯	◯	◯
Separate her from the rest of the flock	◯	◯	◯
Turn her back out with the flock	◯	◯	◯
Cull her	◯	◯	◯
Call another vet	◯	◯	◯

Comment Box - Please use this space if you wish to make a comment or expand on any of your answers

Progress

Next

Section 3 - Management of Lameness

The following questions are about your current recommended lameness management practices

We appreciate that every farm is different and that your advice to individual farmers will vary accordingly.
So when answering the following questions please think about what you have most commonly recommend to clients.
Please use the comment box below if you wish to explain or expand on your answers.

As part of standard lameness management what do you recommend?

	Yes	*No*	*N/A*
Routine foot trimming whole flock	○	○	○
Routine footbathing whole flock	○	○	○
Vaccinating against footrot	○	○	○
Applying lime e.g to pens/races/around feeders	○	○	○
Moving around mineral buckets or feeders in fields	○	○	○

As part of infectious lameness management how often do you recommend....?

	Always/Almost always	*Often*	*Sometimes*	*Rarely*	*Never*
Therapeutic trimming of individuals	○	○	○	○	○
Foot bathing infected individuals	○	○	○	○	○
Using antibiotic or disinfectant foot spray	○	○	○	○	○
Using antibiotic injections	○	○	○	○	○
Separating lame ewes from the rest of flock	○	○	○	○	○
Quarantining new stock	○	○	○	○	○
Turning treated animals out onto a clean and dry area	○	○	○	○	○
Catching and treating mildly lame sheep	○	○	○	○	○
Culling repeatedly lame sheep	○	○	○	○	○
Treating lame sheep within 3 days of noticing them	○	○	○	○	○
Giving anti-inflammatories/pain relieving drugs as part of lameness treatment	○	○	○	○	○

What are the names of the drugs that you use or prescribe to farmers for treating lameness?

Injectable antibiotics

Antibiotic/Disinfectant Sprays

Anti-inflammatories/Pain Relieving Drugs

In the last 12 months how many times have you been called out to a farm for lame sheep?

Comment Box - Please use this space if you wish to make a comment or expand on any of your

answers

Progress

Next

Section 4a- Your opinions on lameness and pain in sheep

The following questions are about your views and opinions, there are no right or wrong answers

Below there are a series of statements, please indicate how much you agree or disagree with each statement

	Completely Agree 1	2	3	4	5	Completely Disagree 6
Many vets are over affectionate towards sheep	○	○	○	○	○	○
It makes me sad to see sheep isolated from the rest of the flock	○	○	○	○	○	○
It upsets me to see sick sheep	○	○	○	○	○	○
Vets that talk to sheep annoy me	○	○	○	○	○	○
It upsets me to see, or hear about sheep that have been attacked or killed by dogs	○	○	○	○	○	○

	Completely Agree 1	2	3	4	5	Completely Disagree 6
Seeing healthy sheep nearly always puts me in a good mood	○	○	○	○	○	○
People often make too much of the feelings of sheep	○	○	○	○	○	○
It is silly to become emotionally attached to a sheep	○	○	○	○	○	○
I enjoy patting or stroking pet lambs	○	○	○	○	○	○
As a vet I get personal satisfaction from helping sheep in pain or distress	○	○	○	○	○	○

	Completely Agree 1	2	3	4	5	Completely Disagree 6
When a sheep is in pain or distress I want to help it	○	○	○	○	○	○
I do all I can do reduce the amount of stress sheep experience from gathering or handling	○	○	○	○	○	○
I don't like being around sheep when they are in pain	○	○	○	○	○	○
Trying to limit the fear sheep experience is a waste of time as they are naturally fearful	○	○	○	○	○	○
It irritates me when pet lambs play around my feet	○	○	○	○	○	○

Comment Box - Please use this space if you wish to make a comment or expand on any of your answers

Progress

Next

Section 4b - Your opinions on lameness and pain in sheep

Below there are a series of statements, please indicate how much you agree or disagree with each statement

	Completely Agree 1	*2*	*3*	*4*	*5*	*Completely Disagree 6*	*Don't Know*
It is difficult to recognise pain in sheep							
Including pain relief in the treatment of lame sheep improves their performance							
Including pain relief in the treatment of lame sheep improves their welfare							
Lame sheep benefit from pain relief as part of their treatment							
Including pain relief in the treatment of lame ewes improves the performance of their lambs							

	Completely Agree 1	*2*	*3*	*4*	*5*	*Completely Disagree 6*	*Don't Know*
I think that pain relief should be part of the treatment of lame sheep							
Treating the disease is the same as alleviating the pain							
It is difficult to recognise pain in sheep							
Some degree of pain is beneficial to sheep							
Pain relieving drugs are not necessary for lame sheep							
Sheep experience pain in the same way as humans							

Below there are a series of statements, please state whether you think they are true of false

	True	*False*	*Don't Know*
There are no pain relieving drugs available for use in sheep			
Pain relieving drugs have to be administered by vets			
Farmers are not permitted to keep pain relieving drugs on farm			

Comment Box - Please use this space if you wish to make a comment or expand on any of your answers

Progress

Next

Section 5 - Farmers

Below there are a series of statements, please indicate how much you agree or disagree with each statement

	Completely Agree 1	2	3	4	5	*Completely Disagree* 6
In general farmers would use pain relieving drugs more often when treating lame sheep if they were cheaper	○	○	○	○	○	○
In general farmers don't think pain relieving drugs are necessary for lame sheep	○	○	○	○	○	○
In general I would feel comfortable discussing with farmers the use of pain relieving drugs as part of the treatment of lame sheep	○	○	○	○	○	○
In general farmers won't use pain relieving drugs when treating lame sheep	○	○	○	○	○	○

Section 6 - Opinions of Others

Please indicate how much you think others would approve or disapprove of you giving pain relieving drugs to lame sheep as part of their treatment

	Highly Approve 1	2	3	4	5	*Highly Disapprove* 6
How much would **other vets** approve of you giving pain relief to lame sheep?	○	○	○	○	○	○
How much would **farmers** approve of you giving pain relief to lame sheep?	○	○	○	○	○	○
How much would **your family** approve of you giving pain relief to lame sheep?	○	○	○	○	○	○

Section 7 - Giving Pain Relieving Drugs

	Total Control 1	2	3	4	5	*No Control* 6
How much **personal control** do you have over whether lame sheep on your clients' farms receive pain relieving drugs as part of their treatment?	○	○	○	○	○	○

	Very Confident 1	2	3	4	5	*Not at all Confident* 6
How **confident** are you that you can provide pain relieving drugs as part of the treatment						

of lame sheep on your clients' farms?	◯	◯	◯	◯	◯	◯

	Very Likely 1	***2***	***3***	***4***	***5***	***Not at all Likely 6***
How **likely** is it that you will provide pain relieving drugs as part of the treatment of lame sheep on your clients' farms **over the next 12 months**?	◯	◯	◯	◯	◯	◯

Comment Box - Please use this space if you wish to make a comment or expand on any of your answers

Progress

Next

Thank You!

We are extremely grateful to you for taking the time to complete this questionnaire

To say thank you we invite you to enter the prize draw for a chance to win £100

To do so please enter your details below and then click on 'Submit'

Your contact details will be separated from your questionnaire responses, and your answers will remain anonymous.
Your contact details will be used only by SRUC researchers to contact you with regard to this study.
Your contact details will not be shared with any other organisation.

Name	
Email Address	
Phone Number	

You will be sent a report on the results of this study. If you do not wish to receive this please tick this box

☐

Progress

Submit